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REHABILITATION OF EUROPE

IN April 1947, a report on the "Economic Conditions of Germany To-day and its International Repercussions" was issued by the special committee of the International Chamber of Commerce; a revised edition, submitted last November to the Council of the International Chamber, has now been published*. Certain of the recommendations of the original report have indeed already been adopted, wholly or in part. For example, a time limit has been given for completion of the earmarking of German machinery and equipment on reparations account, and plants not so earmarked are then to be finally freed from the threat of being taken for reparations. Great emphasis has been given to the problem of coal production, and German industrialists have been given incentive to export by permission to use part of the foreign exchange earned by the products exported to buy raw materials. There has been improvement in the procedure for exporting, and the steel output has now been raised to a limit of 10·7 instead of 5·8 million tons. The Committee, which again recommends that economic authority be given as much as possible to Germans, welcomes the initiative of the British and American authorities in creating a German Economic Council in their bizonal area, with full economic powers, subject to the overriding authority of the Allied Military Government. It also welcomes the adoption of the principle of the rapid devolution of power to central German agencies, and urges the resolute pursuit of this policy.

To restore incentive to the German workers and employers, four measures are recommended: monetary reform, involving a drastic reduction of the present volume of money, restoration of the market over an ever-widening area of the German economy by freeing the prices of non-essentials and gradual adjustment of the prices of controlled goods; fixing a new parity for the mark; extension of the system whereby family rations vary with the output and type of work done by the main wage-earner, and the gradual raising of normal rations; and provision for workers of greater quantities of consumer goods from domestic output and from limited and carefully selected imports, distributed so as to afford the maximum incentive to production. The Committee recommends that the goal should be for the management of Germany's heavy industries to be returned to private enterprise; but the substantial directive control, shareholding and management should be retained in Allied hands for reasons of security.

An increase in Germany's coal output is essential, both for the recovery of Western Europe and in order to terminate Germany's dependence on foreign financial aid; and every possible step should be taken to stimulate production as well as the work of repair and construction of Germany's transport system, and especially of locomotives and rolling stock.

The general aim of policy set out in the report is to reduce government controls as rapidly as possible,

* The Economic Conditions of Germany To-day and its International Repercussions. (Brochure No. 123.) Pp. 46. (Paris: International Chamber of Commerce, 38 Cours Albert 1.)

and to restore a system of free enterprise under which a genuinely democratic society and Government might be established. In framing their policy, the Control Authorities should bear in mind the needs of the rest of Europe and avoid a narrow outlook. The prime task of Europe to-day is to raise its overall production. That requires the use of the Continent's resources, transport and inland waterway facilities in the most efficient way possible, thereby minimizing Europe's overall foreign exchange deficit. If each country—and the Occupying Powers in Germany—seek to minimize their individual foreign exchange deficit unilaterally, the whole process of European reconstruction will be retarded and much effort wasted. Finally, the Committee observes that when political and other considerations make it possible to form a customs union or low-tariff area in Europe to which Germany could be joined, the solution of the economic difficulties of Germany and of the whole of Europe will be materially assisted.

These recommendations, however, only indicate the scope of the report, which gives a clear picture of the situation to-day; quite apart from the suggestions as to the action required, it should materially assist in grasping the position now confronting us. An equally valuable contribution to that end is to be found in a broadsheet, "Local Government in Bizonia", which has been issued by Political and Economic Planning. This broadsheet, moreover, is a valuable study of the nature of democracy which merits attention quite as much from the point of view of the reorganisation of local government in Great Britain with which we are now faced.

The broadsheet is not intended to depreciate the difficulties involved in creating in Germany a democratic local government, or the value of the experiment that is being made in the British Zone. It questions, however, the wisdom of the British policy of following closely the system which has worked well in Britain, and suggests that the utmost flexibility and encouragement of bold improvisation are required. It recommends that much more freedom should be given in the British Zone, as is already done in the American Zone, for experiment, subject to supervision of general policy rather than of constitutional details, and exercised by people aware of local government as an adaptable instrument of administration.

The principles suggested in this broadsheet are not put forward as other than indicative rather than exhaustive. First, a clear line should be drawn between political appointments, whether full or part-time, and the non-political local government service under their direction. The best guarantee that legislation on these lines will be enforced is likely to be found in the service itself when its professional responsibility and *esprit de corps* can be developed. Full-time political administrators, it is thought, must either be elected directly by the people or indirectly by the German Economic Council, and in either case should be subject to re-election at frequent intervals as now happens in the American Zone. Financial control should remain with the Council, and the Council's officers must be answerable to the Council only. Where there is delegation of powers, it must be to the Council as a whole, which should be responsible for seeing that the work is carried out properly. The rights of party minorities must be recognized, and elected members are responsible to the electorate and not to outside members of their party. This means that while there may reasonably be consultation with outside organisations, decisions must be taken by the councillors, and outsiders have no right to see documents or to receive information not available to all electors.

The report from the International Chamber of Commerce makes it plain how closely Britain's own recovery is linked with that of Germany, and it is interesting to note a close parallelism of thought between that report and a recent "Design for Freedom" pamphlet. This pamphlet, entitled "Design For Recovery"*, argues that the failure of Britain to make the expected recovery from the effects of war is due largely to the Government's attempt to centralize the control of industry and to conduct trade on bilateral lines, as well as to irresponsible equalitarian propaganda, which has damped down individual effort. The recovery of Britain, it is urged, depends upon our overseas trade, and in this connexion emphasis is laid on the need for greatly increased production of the goods our customers require at prices they can afford, a restoration of multilateral trading, the re-establishment of sterling in its old position as an internationally accepted currency, and of freedom for the individual producer and trader to show his initiative.

Although the first recommendation is for a reduction of income tax by one third, the measures proposed in the pamphlet differ much less than might be expected from the policies of the Government. The earned income reliefs announced by Sir Stafford Cripps are designed to restore the incentives to greater production, which is the purpose of the reduction of the rate of tax advocated in the pamphlet; while the Government has already given evidence that it is concerned, where possible, to reduce the number of physical controls, to return to multilateral trade and to encourage the development of new sources of wealth. Even the strengthening of financial control, such as the rates of interest, control of credit and scientific taxation so as to reduce inflationary pressure, appear to be less distasteful; although there is as yet no evidence that either of the principal political parties is prepared to consider the fundamental reconstruction of the whole basis of taxation policy.

Much is said in the pamphlet about the importance of Colonial development; the present Government certainly cannot be accused of neglect of the latent resources of Colonial territories. The pamphlet, however, tends to neglect the practical and psychological difficulties which face any Government; although its support for the development of new resources, the encouragement of invention and the use of science to control pests and increase production should be welcome to the Government in view of

* Design for Recovery. Pp. 44. (Design for Freedom Committee, 22 Chester Square, S.W.1.)

some of its new proposals. Its criticism, moreover, points a way by which financial controls to reduce inflationary pressure may in themselves facilitate a large reduction of the physical controls which cause delay and waste, and encourage more fruitful co-ordination and stimulation in a freer economic life.

Where the pamphlet links up its design with the International Chamber of Commerce report, however, is in its emphasis on European economic unity as essential to recovery. It urges as a first step the development of a system of currency interchangeability on the lines of the recent agreement by France, Italy and the Benelux countries, and that this agreement, utilizing the Bank of International Settlements, should be extended to all the sixteen nations participating in the European recovery programme. When Sir Brian Robertson, in his address on April 7 to the State Assembly of Rhine–Westphalia at Düsseldorf, affirmed the will of the Western Powers to pursue their plans for German recovery in face of the 'Iron Curtain' and the tense situation in Berlin, he called on the new Germany to take its place as one of the great nations of Western Europe. In his broad review of the political and economic scene, he gave no forecast of allied intentions for the progressive development of German political organisations or for the transfer of authority and responsibility to German hands; although he did emphasize that the ultimate objective of the bizonal administration in Frankfurt is to lay a foundation on which German unity with an independent, freely elected and representative government could be restored, a unity which would ensure to the people of Germany and their children the elementary freedoms of President Roosevelt.

The implications of this speech are as important as its content. The appeal to accept the prospects of security and reconstruction which the Marshall Plan and the Western Defence Pact offer mean that there can be no retreat at Berlin. While the division in Germany is absolute for the time being, Sir Brian's speech makes it clear that everything must be done to secure the confidence of the German people that the Western Powers will stand firm. Without that, plans and prospects everywhere in Germany, if not in Western Europe, will be shattered.

It is well that the British people as well as the German people should clearly understand what is at stake and how their future is interlocked. There has already been tabled in the House of Commons a motion urging the creation in Western Europe of a political union strong enough to save European democracy and the values of Western civilization, and a trading area large enough with the Colonial territories to enable its component parts to achieve economic recovery and stability. For this purpose the motion advocates the establishment forthwith of a Council of Western Europe consisting of representatives of the sixteen countries participating in the European Recovery Plan and Western Germany, with power to set up permanent international staffs to co-ordinate the social, economic and defence policies.

The first and most important task of the economic staff would be to frame concrete proposals for stabilizing the currencies of Western Europe, for the development of trade, for executing the European Recovery Plan, for a comprehensive production plan, including agriculture and the heavy industries, and for Colonial development. The long-term policy should be to create a democratic federation of Europe with a constitution based on the principles of common citizenship, political freedom and representative government, including a charter of human rights. Such a federation should have defined powers in such matters as external affairs, defence, currency, Customs and the planning of production, trade, power and transport.

Soviet intransigence has thus given an impetus to federation which a year ago was inconceivable. The convening of an assembly to frame a federal constitution for Western Europe has been brought within sight of the bounds of practical politics. In Great Britain, the idea of a United Europe, whether by federation or other means, has strong support from all political parties and has received powerful encouragement from statements made by the Foreign Secretary. Formidable difficulties will yet lie in the way of translating the declaration of principle into practical policies and bold executive measures, and success or failure will depend to a large extent on the support of an informed and intelligent public opinion. The pamphlets noticed above, no less than Sir Brian Robertson's speech, are to be welcomed as useful contributions to the formation of such an understanding and alert body of public opinion. The development of a body of opinion on this subject, not only in Britain but also in the other European countries concerned, is the indispensable first step towards the realization of any such long-term policy of federation contemplated in the second part of the all-party motion to which Mr. Churchill referred in the House of Commons on April 7.

SONS OF CAMBRIDGE

Alumni Cantabrigienses

A Biographical List of all known Students, Graduates and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. Compiled by Dr. J. A. Venn. Part 2: From 1752 to 1900; Vol. 3: Gabb—Justamond. Pp. iv+619. (Cambridge: At the University Press, 1947.) £7 10*s*. net.

A WELCOME must be given to this further volume of Dr. Venn's *magnum opus*. Much of historical interest in the life of Britain is to be garnered in its 619 pages of biography. In reviewing them we shall not attempt to summarize the records of the divines, the statesmen, the medical men, the schoolmasters and the soldiers, but shall touch upon points of interest to scientific readers and upon some of the odd items of biography which enlighten its pages.

More than ninety fellows of the Royal Society have been noted, of whom the largest group consists of statesmen, lawyers and people in public life; the

second group of mathematicians and astronomers; then representatives of medicine and the medical sciences, and then geologists. From among them mention may be made of William Hamilton, who saved for England the famous Rosetta stone; William Jones, the first Englishman to master Sanskrit; and Richard Gough, the archæologist, whose life in Cambridge must have been marred by shyness, for he scarcely ever stirred out of college without his tutor and he left his magnificent library to the Bodleian; also the Rev. William Vernon Harcourt, founder of the British Association. Other clergymen may be mentioned in William Hildyard, who had six sons who became fellows of colleges; James Inman, a Naval chaplain who improved shipbuilding and gunnery; Henry Gwyther who, when vicar of Yardley, caused three barrow-loads of parchments to be burnt; and John Jope, whose dead son haunted the church and vicarage of St. Cleer, Cornwall, until the father "consented to his remaining in the shape of a spider, and gave him as a hiding-place a crevice in the mantelpiece". His was a case which would have interested Edmund Gurney and Richard Hodgson of the Society for Psychical Research, who both appear in this volume.

Viceroys and governors head a long list of distinguished statesmen: here we will only mention James, Marquess of Graham, who obtained permission for the Highlanders to resume their national dress, long banned. Wars figure in the biographies of many soldiers and civilians turned soldier; we must mention William Hope, who won the V.C. in the Crimean War; William Hodson of Hodson's Horse, which did more than any other regiment to save India for the British at the time of the Mutiny. Travellers and explorers include Francis Guilleward (the Marquesas), Walter Harris (Morocco), George Haviland (Borneo), Sydney Hinde (Upper Congo) and Frederick Jackson (East Africa)—the original of Captain Good in "King Solomon's Mines". Books of adventure recall Henty and Cutcliffe Hyne, creator of Captain Kettle. Great athletes include Goldie, of the Goldie boathouse; Hockin, of immense size and strength, picturesque in his exhortations to a crew, who rowed seven years in the Jesus boat while it was 'head of the river'; the Gurdon brothers (Rugby football), Hammer Hales, S. S. Harris (association football), Lord Hawke, F. S. Jackson and A. O. Jones (cricket), L. K. Jarvis, a triple 'blue' and a member of the famous eleven that beat the Australians in 1878, Gatehouse (tricycle champion), and Hutchinson, who rowed with Steve Fairbairn for twenty-five years, and by a slip of the pen gave his age as '45' instead of '54' so as to get into the Durham Light Infantry in the First World War.

From the many miscellaneous items of interest a short selection must be made: Frederick Gill of Trinity was described by Francis Galton as possessing a grand nose, the glory of his College; John Griffith, chaplain of Ely gaol, bequeathed his housekeeper the ropes he received after each hanging, and she sold them for the cure of sore throats; A. P. Humphry, the long-distance shot, was reputed to have tested his marksmanship by firing from the tower of the Pitt Press on targets on the University range; Holditch, president of Caius for thirty-two years, was so shy and so rarely seen that a fellow of his own college once showed him round the college, taking him for a stranger. A wide range of similar stories is to be found by looking carefully through this interesting volume.

F. J. M. Stratton

'LITTLE FLEAS' AND 'LESSER FLEAS'

Parasites (animaux et végétaux) des helminthes

Hyperparasites, ennemis et prédateurs des helminthes parasites et des helminthes libres; essai de compilation méthodique. Par Robert Ph. Dollfus. (Encyclopédie biologique, 27.) Pp. viii + 482. (Paris: Paul Lechevalier, 1946.) 1500 francs.

NOT only helminthologists, but others also who are interested in parasitism, will be grateful to Dr. R. Ph. Dollfus for this addition to his well-known and valuable work. For many years he has been collecting for his own use records of the hyperparasites and other enemies of trematodes and cestodes, and also of both parasitic and non-parasitic nematodes. He had no intention of publishing these; but his colleagues have urged him to do so, and the result is this very useful volume. The author does not claim that it is complete and he has published the various records as he found them, without critical evaluation by himself. Some of them consist of notes or a few words only, but the 26 pages of references enable the reader to consult the majority of the sources from which the records have been derived. Critical evaluations will, says Dr. Dollfus, come later, when the doubtful organisms recorded have been found and described again. We shall then perhaps be in a better position to decide whether there are any biological reasons for the fact that the records of the enemies of the cestodes and trematodes collected by Dr. Dollfus occupy only 50 of the 482 pages of the book, while the remaining pages are given to the enemies of the nematodes. It seems unlikely that this disproportion is the result of greater attention given either by Dr. Dollfus or by biologists in general to the enemies of the last-named group.

Prof. Emile Brumpt, in his introductory preface, regards the book as a first step in the study of an important field, and he suggests that the enemies of the helminths may influence the non-parasitic phases, at any rate, of their life-histories, as much as physico-chemical factors do. One may doubt this; but the suggestion certainly opens up a field of work which needs investigation.

Many readers will no doubt be astonished at the number and variety of the organisms which attack trematodes, cestodes and nematodes. Best-known among them perhaps are the fungi, which destroy by various methods both parasitic and non-parasitic nematodes; these are well described and illustrated in the 245 pages given to them. Readers who are interested in this subject will remember Dr. Dreschler's valuable and suggestive essay in *Biological Reviews* (**16**, 265; 1941). Less well known are the bacteria, spirochætes and protozoa which attack trematodes, cestodes and nematodes. The systematic position of some of these is still doubtful, and more work is needed upon them. In the bodies of trematodes phases of the life-histories of nematodes, trematodes and cestodes have been found; in some cestodes the larvæ of nematodes, cestodes and trematodes have been recorded; and, apart from the nematodes which eat other nematodes, there are species of this class which have been found inside the bodies of other species of nematodes.

Whether all the helminths which thus appear to be parasitic are really so or not we shall not know until much more work upon them has been done. Some of them may be only accidental associations

and others may be instances of commensalism, similar to those associations between different species of nematodes which Dr. Dollfus does, in fact, describe as instances of commensalism. The distinction between commensalism and parasitism is not, of course, sharply defined, and, when organisms associated together are, like many of those mentioned in this book, comparatively difficult to obtain and certainly not easy to study under controlled conditions, it may be difficult to place them in either category.

What we need is more knowledge of the physiology of these organisms, and it may be that, in the process of acquiring it, new aspects of the relationships between parasitism and other forms of animal associations will be opened up. Dr. Dollfus has certainly provided in this book an extensive and detailed survey of such knowledge as we have, and it is to be hoped that he will follow it up with a critical estimate embodying his own wide experience.

G. LAPAGE

DIVINATION IN DAHOMEY

La Géomancie à l'ancienne Côte des Esclaves

Par Bernard Maupoil. (Université de Paris : Travaux et mémoires de l'Institut d'Ethnologie, Tome 42.) Pp. xxvii+690+8 plates. (Paris : Institut d'Ethnologie, 1943.) 320 francs.

M. MAUPOIL, during a tour of administrative duty in Lower Dahomey during 1933–36, made an extensive study of the Ifa system of divination, which plays such a large part in the religious life of the Yoruba and of their neighbours in Dahomey who have borrowed it from them. Although to the masses Ifa, or Fa as it is called in Dahomey, has become personified as a god, to the initiated it is more truly the voice of god or of fate. Unlike the cruel, capricious and unreliable gods of the Dahomey and Yoruba pantheon, Ifa is infallible, impartial, and never deceives. It consists of an abstract method of divination by manipulation of sixteen palm nuts, in the course of which a number of signs are made with the fingers in a yellow powder placed on a special tray. It is these signs which reveal to the initiated practitioner the past or the future. In its simpler form Ifa gives the consultant an answer to the everyday problems of his life; in its more esoteric, it gives him an opportunity of discovering his destiny.

Though Ifa may represent a man's fate and cannot be tricked or deceived, the Yoruba or Dahoman does not feel unduly terrified of his destiny, for there may still be a chance of avoiding it. This power which may enable a man to escape his fate is found in the conception of Legba, a being defined by Prof. Herskovits in his anthropological study of Dahomy as the personification of accident in a world where destiny is inexorable. M. Maupoil has of necessity a good deal to say about this roguish priapic messenger of the gods who spends his time deceiving both gods and mortals, and who plays such unpleasant tricks on them that early missionaries could only consider him the Dahoman personification of evil. He comes to the same conclusion as does Herskovits, that Legba is not the Dahoman counterpart of the devil, but that he supplies that principle of chance needed to humanize and make tolerable the rigid inexorable discipline of Ifa.

M. Maupoil is also impressed by the wisdom and sincerity of the Bokono (Yoruba, Babalawo), the priests or practitioners of Ifa, who play such an important part in Dahomey social life, a part sadly neglected and ignored by missionaries and administrators. The Bokono is called upon to intervene incessantly in social and family matters, and his balanced and philosophic outlook finds constant opportunity for expression through his divination. This wisdom, concealed in the proverbs and mythological tales by which the Ifa signs are revealed, helps to maintain the solidarity of the social group among whom the Bokono lives and practices, and gives it the equilibrium it needs to withstand the vicissitudes of its existence.

The absence of serious anthropological research on the Yoruba people and their sacred city of Ife constitutes a most unfortunate gap in our knowledge of West African peoples and their descendants in the New World. In default of such studies, students have, of necessity, to refer to works like the present one, which relate to peoples to whom this Yoruba culture has been transmitted. They will be very grateful to M. Maupoil for this most comprehensive study of Ifa. Though his field-work had necessarily to be confined to Dahomey, he has taken considerable trouble to consult, and where needed, to quote, all the available authorities on the Yoruba Ifa, in particular Mr. J. D. Clarke, some of whose notes have not received publication elsewhere. "La Géomancie à l'ancienne Côte des Esclaves" will therefore remain the standard work of reference on Ifa divination for many years to come.

G. I. JONES

ANATOMY OF THE RENAL CIRCULATION

Studies of the Renal Circulation

By Dr. Josep Trueta, Dr. Alfred E. Barclay, Dr. Kenneth J. Franklin, Peter M. Daniel, Marjorie M. L. Prichard. Pp. xix + 187. (Oxford : Blackwell Scientific Publications, Ltd., 1947.) 25*s*. net.

MOST text-books of histology provide detailed diagrams illustrating the intricacies of the vascular pattern in the kidney, and, indeed, the classical work of Bowman, Virchow, Huber, MacCallum and others would appear to have exhausted the purely anatomical aspect of this system. But it seems that this provides yet another example of those 'comprehensive' studies the completeness of which is only apparent. For evidence has now been adduced demonstrating that a fundamental point in the renal circulation has hitherto been entirely overlooked—the fact that it comprises a *dual* system. The kidney, it appears, has two potential circulations, a greater, which traverses the cortex and involves the cortical glomeruli, and a lesser, which is confined to the medulla and the juxta-cortical glomeruli. While in normal circumstances the circulating blood passes through the cortex, under certain conditions it may by-pass it entirely through the lesser circulation.

This is the theme, abundantly documented by experimental evidence, of the monograph which has recently appeared from the Nuffield Institute for Medical Research at Oxford. This monograph represents the product of team-work which was initiated in order to determine whether the renal failure which occurs in the victims of crushing injuries to the limbs might be due to reflex vascular

disturbances. The results of the investigation depend largely on the application of angiographic studies in living animals, and also on a radiomicrographic technique which is evidently capable of providing extraordinarily accurate information of small but important vascular disturbances. With the aid of such methods, it was possible to demonstrate that by a variety of procedures (such as the application of a tourniquet to a limb, the stimulation of the sciatic nerve, and the injection of staphylococcus toxin) a cortical ischæmia in the kidney can be induced which may be severe enough to lead to an actual necrosis. The clinical implications of these observations are clear, and it is no exaggeration to say that they are of profound importance for the consideration of a number of problems of renal pathology, particularly since the vascular effects observed are believed to have primarily a neurogenic origin.

Undoubtedly one of the outstanding features of the monograph is the profusion of most excellent photographs demonstrating the effects of various procedures on the vascular pattern in the kidney. These certainly carry conviction so far as the actual recorded observations are concerned. While the authors make it clear that the precise relationship of these vascular changes to disturbances of renal function in pathological conditions is still a matter of hypothesis, they have nevertheless succeeded in directing attention to a factor which may well prove to be of major importance in their elucidation. The style of presentation is commendable for its directness and simplicity, and for the care which has been taken to avoid any over-statement of the case which the authors put forward.

REASON IN THE MODERN WORLD

Eclipse of Reason

By Max Horkheimer. Pp. ix+187. (New York and London: Oxford University Press, 1947.) 16*s.* net.

THIS is a rather difficult book; not that the author's exposition is unclear—on the contrary, he writes well; but that his general position is difficult to grasp. It is important to grasp it, because he makes a profoundly suggestive diagnosis of the intellectual sickness of our day.

The main thesis can perhaps be summarized without too much distortion as follows. The confusion of thought of the modern world is not just academically deplorable; it leads to confusion in political, economic and other social activities. It springs from deserting 'objective reason' for 'subjective reason'. The notion of objective reason is that there exists in the universe an intelligible order to which the thought and action of men should conform, as Plato and Aristotle believed. We have replaced that notion, through what is possibly an inevitable process, by subjective reason, which means obtaining an adequate mental grasp of socially approved means to ends. The ends themselves are left undefined as a sort of continuation of the means, or else interpreted as self-preservation, either of individuals or of some society on the preservation of which the individual life depends. In effect, such an attitude destroys all proper relations between society and individuals, and even makes the natural world appear to be the enemy of men or their master. (The argument for these conclusions is intricate and cannot be abbreviated.)

The favourite philosophies of to-day, the various forms of positivism, including pragmatism and Marxism, all adopt the point of view of subjective reason. In consequence they all become just 'ideologies' in the original sense of the term, propaganda for political parties disguised as rational discourse. Neo-Thomism is condemned by Prof. Horkheimer, though less severely, as archaistic, an attempt to revive something for which the necessary conditions have passed away. In its own way it also becomes political propaganda. Objective idealism of the Hegelian type is dismissed cursorily, though the author's way of thought appears to be akin to it. What is there left? The author says we need philosophy, but he is understandably cautious about putting forward another bit of political propaganda; so he says no more than that philosophy should be the memory and conscience of mankind. This is a pregnant saying, even if it means 'Back to Socrates'. Socrates has been more effective than other philosophers or than any of his contemporaries—but at a price.

A. D. R.

ANIMALS AND THE LABORATORY

The UFAW Handbook on the Care and Management of Laboratory Animals

With an Appendix on Statistical Analysis. Edited by Prof. Alastair N. Worden. Pp. xvi+368. (London: Baillière, Tindall and Cox, 1947.) 31*s.* 6*d.*

SCIENCE owes much to animals employed in laboratories. Guinea pigs, rats, mice, ferrets, etc., have helped greatly in many a valuable research. The care of such animals is important, both from the humane point of view and that of scientific investigation. The handbook under notice, edited by Prof. Alastair Worden, is indeed a useful volume. There are some twenty-three chapters by various writers. Major Hume leads off with "Law and Practice: the Rights of Laboratory Animals", and his chapter is followed by one on the laboratory where animals are kept, including construction, equipment and so on. Pests of the animal house are next considered, after which we go on to the various animals commonly and uncommonly employed in laboratories, each chapter being written by an authority on the species being dealt with.

As might be expected, the rabbit has pride of place, with the guinea pig next and the Norway or brown rat in the third chapter; though some of us might have expected the mouse to come earlier than Chapter 5. Many animals have been pressed into the service of science, from the common house mouse, *Mus musculus*, to the field vole, *Microtus agrestis*, and their suitability by reason of size, ease of handling, rapidity of breeding and other characteristics is obvious at a glance; but the most remarkable on the list is undoubtedly the hedgehog. That this most unaccommodating creature, ever ready to roll itself into an impenetrable ball of prickles, should have been utilized in research work says much for the enthusiasm and ingenuity of the workers; but utilized it has been, and with success, and in this volume we can learn how to keep, feed and handle it, how to breed it, about its diseases, etc.

The book is a mine of information, and will be indispensable to all engaged in research where animals are employed.

FRANCES PITT

A Manual of Vacuum Practice

By Dr. L. H. Martin and R. D. Hill. Pp. x+120. (Melbourne: Melbourne University Press; London: Oxford University Press, 1947.) 10*s.* 6*d.*

THIS manual, which is written by the professor and senior lecturer of the Physics Department of the University of Melbourne, is an excellent addition to the all too few modern books in the English language on vacuum technique. So many appliances to-day depend upon the production and maintenance of a high vacuum that not only the physicist and research workers in other branches of science, but also the engineer and many industrial technicians need to have a working knowledge of vacuum processes. No book can take the place of actual practical experience; but even the most experienced vacuum worker will find it extremely useful to keep by him such a handy reference book as this, for it describes in a concise and practical form not only modern developments in vacuum apparatus, but also presents in an easily accessible form valuable data concerning the properties and uses of materials most suitable for vacuum systems.

The physical principles of the production of low pressures, together with some typical calculations which were made in designing the pumping system for a neutron generator, are described in Chapter 1; the various gauges for pressure measurement in Chapter 2; pumps in Chapter 3; and materials, valves, joints, traps, etc., under the general heading of 'vacuum plumbing' in Chapter 4. Eighteen appendixes, including details with regard to soldering, cleaning of mercury, making glass-to-metal seals, and greases, waxes and cements, together with a comprehensive index, complete the volume. The clarity of the numerous diagrams and drawings, many of which are provided with actual dimensions, will be greatly appreciated by those who design and construct their own vacuum systems. Each chapter is provided with a list of references to the original sources, and the commercial apparatus referred to in the text includes both English and American types of the most modern pattern. The book is small enough to be slipped into the laboratory coat pocket. It is excellently printed and well bound with a special ring binding which allows the book to open and remain quite flat, an important feature especially when the user's hands are occupied with some practical job.

Aristotelian Society

Supplementary Volume 21: Explanation in History and Philosophy. The Symposia read at the Joint Session of the Aristotelian Society and the Mind Association at Cambridge, July 4th–6th, 1947. Pp. iv+218. (London: Harrison and Sons, Ltd., 1947.) 21*s.* net.

THE title of this modest little volume is a masterpiece of understatement. The contents are immeasurably richer than the word 'explanation' would suggest. Prof. C. D. Broad leads off with some characteristically stimulating observations upon methods in speculative philosophy. (Actually, his address came in the middle of the conference, not at the beginning.) The symposia proper deal with historical explanation, truth by convention, the psychological study of mental acts or dispositions, and the problem of guilt.

Interesting as all this is, it is hard to find much coherence, and harder still to get any very definite impression of aim. To attempt to do so would be misleading, beyond the remark that the headings do represent the spirit of the discussion. But the point is this, that the conference room was evidently a philosopher's workshop, where things could safely be left lying about, without having to tidy up for the night. This is one of the most promising and creative ways of fashioning thought, and the Aristotelian Society may be congratulated upon the results. No less a scholar than the late Canon Streeter commended the intellectual workshop, and was himself an adept in handling its tools and assembling the bits and pieces. The speakers reported in this book have done likewise and deserve our gratitude.

So far as the more strictly historical matter is concerned, it is wholesome to be reminded that events really did happen—for good or for ill—and that the sequence of occurrences has a reality of its own, independent of the design into which a later historian may desire to weave them. F. I. G. RAWLINS

Housing the Country Worker

By Michael F. Tilley. Pp. 152+24 plates. (London: Faber and Faber, Ltd., 1947.) 12*s.* 6*d.* net.

THE importance of housing in Britain in relation to agriculture and the use of the land in rural areas was well brought out in the Scott Report, and has been stressed in recent discussions in connexion with the Government's agricultural policy and the housing situation in general. Mr. Tilley has discussed lucidly and most readably the broad aspects of the whole problem as seen against the changes in farming organisation and practice, the rural location of industry and the political, economic and social questions involved. There is an admirable chapter on the village plan, followed by others on the provision of public services, the repair and reconditioning of old buildings, the needs of the country worker as distinct from the urban dweller, recent housing developments and materials and equipment. This sane and balanced discussion, which always has close regard to the personal needs of those primarily concerned as well as to what is practicable, taking into account the materials available and the efficient use of sites and land, points the way towards harmonizing anew the erection of new houses and the advent of a new population on one hand and the existing structure of the village in all its aspects. These possibilities are clearly indicated, and the book should be read with interest not merely by the architect or builder, the rural councillor or others actively concerned with the preservation of the countryside, but also by the townsman accustomed to use the country as a week-end resort or daily dormitory. There is much in this book which should further the establishment of good relations between town and country as well as the new tradition of good planning and building worthy of the best in the past, to foster which is the primary purpose of the book. R. B.

A Planned Auxiliary Language

By H. Jacob. Pp. 160. (London: Dennis Dobson, Ltd., 1947.) 10*s.* 6*d.* net.

ONE of the suggestions for the scientific programme of the United Nations Scientific and Cultural Organisation made by the Mexican Delegation at the Conference of the Natural Science Committee of the Preparatory Commission in June last year was that a single international scientific language should be chosen from among German, English, Spanish, French, Latin, Russian and Chinese

as the official language for international scientific conferences, congresses and other meetings, and scientific works written in any other language should always include a sufficiently full summary in this international language. The difficulties in the way of adopting any suggestion on these lines are obvious, though the numerous international scientific conferences during the past year have directed fresh attention to the need. This comparative review of the five systems of planned international language already proposed—Esperanto, Ido, Occidental, Novial, and Interlingua—merits careful consideration. Dr. H. E. Palmer contributes a preface describing the various approaches which have led to the proposals for artificial or planned languages, and after discussing the functions of a planned language, Mr. Jacob describes the five systems and then considers in succession the structural problems of the planned language and present-day movements in this field. Two chapters on the preliminary project of the Russian Academy of Sciences for a technical nomenclature, and on technology and the language problem, appear to exaggerate the barrier which language has placed to technical communication, and the treatment of nomenclature is altogether too superficial. There is an adequate bibliography.

Petroleum Production

By Park J. Jones. Vol. 3: Oil Production by Water. Pp. vii+271. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1947.) 30s. net.

WATER in oilfield development can be both a blessing and a curse. This volume deals with the former condition, although the alternative never seems far behind. Briefly, recoverable oil can be classified as dry, wet and marginal reserve. "The ratio of dry to wet oil reserve depends on how soon water appears in production." Obviously it is far more economical in every sense to produce dry oil than wet oil, and every operator strives to achieve the first, if not to control the second to his advantage.

In this thesis of oil production by water, theoretical considerations take care of the normal condition 'oil ahead of water', oil production by expansion, well producing capacity, injection of water, optima for reservoirs and oil migration. Practical applications concern radial reservoirs, two-pay intervals, impermeable wedges, saturated oil, linear and elongated reservoirs and bottom water. The author is clearly a master of his subject, but the reader needs more than average mathematical knowledge to follow all the arguments. The book is well produced and the text clarified by numerous graphs and line drawings.

H. B. MILNER

New Developments in Ferromagnetic Materials

With Introductory Chapters on the Statics and the Dynamics of Ferromagnetism. By J. L. Snoek. (Monographs on the Progress of Research in Holland during the War.) Pp. viii+136. (New York and Amsterdam: Elsevier Publishing Co., Inc., 1947.) 6.75 fl.

QUITE apart from any other, this brochure is of interest as illustrating some of the work done by Dutch men of science during the period of the German occupation. Starting off with general accounts of what the author terms the statics and dynamics of ferromagnetism, the main interest lies in the work done on the development of new magnetic materials based on the cubic $MO.Fe_2O_3$ compounds. The interesting fact emerges that the oxides containing zinc have higher permeabilities than the rest, presumably because the Curie point is lowered, the maximum permeability being found to occur just below this temperature. The samples are prepared by a sintering technique which is described, and in the case of mixed NiO, ZnO compounds, a maximum initial permeability of 4,000 has been obtained. Among the appendixes is one dealing with the decarburization of steel. The author claims that the rate of diffusion of carbon in α-iron is very much higher than that in the γ-modification, a view which is contrary to current opinion, and which requires further confirmation before it can be accepted. F. C. T.

Proceedings of the First Canadian Mathematical Congress, Montreal, 1945

Pp. xliv+367. (Toronto: University of Toronto Press, 1946.) 3.25 dollars.

CANADIAN mathematics, at least in the English-speaking provinces, followed closely the English pattern of the nineteenth century. On the other hand, the Canadian school system had many points in common with that of the United States. As years elapsed, the distance of Canada from Great Britain and the traditional fear of being dominated by the United States prevented Canada from following the mathematical advances in either of these countries. This tendency towards isolationism has been aggravated by the lack of intercourse between different parts of Canada itself. A great step in overcoming these defects has been taken by the institution of the Canadian Mathematical Congress, the first meeting of which took place at Montreal in 1945. There were several lectures, some by Canadians and some by distinguished visitors such as G. Birkhoff and L. J. Mordell, research papers, and discussions on methods of fostering research work, on recent advances in statistics, and on the teaching of mathematics to engineering students and in schools. Most of the proceedings were in English, but a few were in French. It was resolved to recommend the founding of a mathematical journal. H. T. H. P.

Mathematik, Logik und Erfahrung

Von Prof. Dr. Victor Kraft. Pp. vii+129. (Wien: Springer-Verlag, 1947.) 10 francs.

IN this modest little volume are signs of intense application and erudition, under conditions (in Vienna) truly 'impossible' as judged by British standards. There is nothing very new in these pages, suggestive as they are. The first half of the book deals with the empirical validity of mathematics—arithmetic and geometry—whereas the second is concerned with a spirited refutation of 'conventionalism', and a discussion of the conditions of application of logic. The prospective reader will naturally ask what this particular brand of conventionalism is to which Prof. Kraft devotes so much attention. It seems to be a species of what we should call idealism in natural law. By relegating it to the *Hinterland*, a healthy relationship is probably established (especially for the intellectual climate in which the author writes) between physics and epistemology; on the other hand, if everybody went all the way with him, there would be but scant quarters left for the 'poetry' of science, of which recent years have produced superb examples in other parts of the world. Nevertheless, Prof. Kraft has enriched his subject, and added distinction to its literature. F. I. G. RAWLINS

AFRICAN FOSSIL PRIMATES DISCOVERED DURING 1947*

By Prof. W. E. Le Gros Clark, F.R.S.
Department of Human Anatomy, Oxford

THE elucidation of the fossil record of the group of mammals of which man himself is a member is clearly a matter of the most profound interest. But it is a study which in the past has progressed extremely slowly, for the reason that the remains of fossil Primates are usually found only at rare intervals. It is all the more remarkable, therefore, that the year 1947 was outstanding in the field of palæontology for the great abundance of extinct representatives of the higher Primates, the Hominoidea, which have come to light. These discoveries were made in Africa, and it is particularly interesting to note that they followed so closely on the Pan-African Congress of Prehistory, held in Nairobi in January of that year, when the implications of earlier finds first gained a wide recognition. The discoveries are due primarily to two men of science, Dr. Robert Broom in South Africa and Dr. L. S. B. Leakey in Kenya.

The new discoveries made by Dr. Broom supplement those which he made between 1936 and 1941 at Sterkfontein and Kromdraai, and which he described in detail in a monograph published in 1946 [1]. They are remarkable both in quantity and quality, for not only do they include considerable numbers of skulls, jaws, teeth and limb-bones of the Australopithecinæ, but also some of this material is extraordinarily complete and well preserved.

It will be recalled that the first specimen of the Australopithecinæ, an immature skull with an endocranial cast, was found at Taungs in 1924 and afterwards described by Prof. Raymond Dart [2]. Then in 1936 and later, Dr. Broom found portions of several adult skulls, jaws and teeth, as well as fragments of some limb-bones, at Sterkfontein and Kromdraai near Johannesburg. His report on this material made it clear that the Australopithecinæ were ape-like creatures with brains of simian dimensions, but which at the same time showed such a remarkable assemblage of characters hitherto regarded as distinctive of the Hominidæ that there could be little doubt of their importance for problems of human evolution. Among these hominid characters may be mentioned the morphology of the frontal region of the skull, the low level of the occipital torus, the construction of the tympanic region, the forward position of the foramen magnum, the palatal contour, the small canines, the bicuspid character of the anterior lower premolars, the morphology of the first deciduous molars, the flat wear of the molars, the details of the lower end of the femur, and certain features of the talus and the capitate bone. The evidence of the femur, combined with that of the foramen magnum, it should be noted, seemed to make it clear that the Australopithecinæ were capable of assuming an erect posture closely approaching that of man.

This accumulation of evidence was sufficient to convince most anatomists that the importance of the Australopithecinæ had not been exaggerated. A few critics, however, expressed scepticism, mainly, no doubt, because they had not had the opportunity of examining the original material for themselves. It is also a fact, however, that this material, although abundant, was in some respects fragmentary, and thus required a rather intimate acquaintance with the comparative osteology of the Hominoidea for a correct appreciation of its unusual characters. Early in 1947, Dr. Broom renewed his excavations at Sterkfontein, and in April announced the discovery of a practically complete adult Australopithecine skull, as well as the upper jaw of another adult, an upper jaw of an adolescent, and some isolated teeth [3]. The complete skull has been listed in the material from Sterkfontein as "Skull No. 5". Further excavations soon showed that many more remains of the Australopithecine fossils were embedded in the limestone matrix in the same area at Sterkfontein, and parts of at least five other skulls (some of which are fairly complete) have since come to hand. The preliminary notes on these discoveries so far published have now provided a remarkable vindication of the views previously expressed by those who had personally studied the earlier material described by Dart and Broom. For example, they appear to confirm the forward position of the foramen magnum and the human resemblances in the occipital and tympanic regions, while many other features such as the contour of the frontal region and the shape of the dental arcade conform closely with the evidence already supplied by less complete material. The discovery of a massive jaw in June 1947, with all the teeth in position, has also added further evidence that the canine was relatively small (compared with the premolars) and became worn down flat to the level of the adjacent teeth [4]. In all these skulls the endocranial capacity seems to vary about 500 c.c.

Dr. Broom, however, has not only found a number of skulls, but has also collected a considerable number of limb-bone fragments, including portions of a scapula, humerus and femur, a tibia, some ribs and vertebræ, and an almost complete os innominatum [5]. The last-named is without doubt the most remarkable find. In the shape of the ilium it corresponds very closely with that of man, and shows no resemblance at all to the os innominatum of an anthropoid ape. Indeed, it provides the final proof (if further proof were needed) that the Australopithecinæ stood and walked in approximately human fashion. So human in appearance is this fossil bone that the question may well be raised whether it really is part of an Australopithecine skeleton. But, apart from the fact that it is entirely consistent with the evidence previously provided by the femur and talus (and also the construction of the base of the skull), it was actually found by Dr. Broom embedded in a block of limestone matrix with portions of several other limb-bones, vertebræ and ribs and with a crushed Australopithecine skull. There can scarcely be any doubt, therefore, that all these bones are the remains of the skeleton of a single individual. It should be noted, also, that in certain features of the os innominatum, such as the details of the ischial tuberosity, it shows unusual characters which, it seems, are not paralleled either in the modern anthropoid apes or man.

* Substance of a communication to the Linnean Society, April 22, 1948.

It will naturally be some time before a detailed account of all this new material from Sterkfontein can be published, but private communications, together with unpublished photographs and drawings, make it clear that the information now available on the anatomy of the Australopithecinæ is astonishingly complete. Stated briefly, they are ape-like creatures in respect of the general proportions of the brain-case and jaws, but approach the Hominidæ closely in the constructional details of the skull, in numerous features of the dentition, and particularly in the limb skeleton. There is no sign yet that the rich 'lode' of Australopithecine material discovered by Dr. Broom is yet approaching exhaustion, and thus there is a reasonable possibility that further remains of the hand and foot skeleton may be found which will permit an even more precise definition of the status of these extinct hominoids. But, when all the evidence now available is published, systematists will inevitably be faced with the question whether the Australopithecinæ should not be allocated to the Hominidæ rather than the Pongidæ.

Simultaneously with these remarkable discoveries of fossil hominoids in South Africa, discoveries of similar importance were being made in Early Miocene deposits of Kenya by Dr. L. S. B. Leakey and Dr. D. McInnes. In 1931, Dr. A. T. Hopwood described some fossil jaws and teeth recovered from Koru in Kenya and assigned them to three new genera of extinct anthropoid apes, *Proconsul*, *Xenopithecus* and *Limnopithecus*[6]. Afterwards, more Early Miocene material referable to these genera were obtained on Rusinga Island and adjacent areas by Leakey[7] and McInnes, and were described by the latter in 1943[8]. Following the Pan-African Congress on Prehistory, some of the delegates had the opportunity of visiting the sites of these discoveries and were impressed with the possibilities of further excavation. A British-Kenya Miocene Expedition was therefore organised with the aid of a grant from the Royal Society, with Dr. Leakey as field director. The expedition proved to be an outstanding success, for almost fifty specimens of fossil hominoids were collected[9]. This material is now being examined in the Department of Anatomy at Oxford, and the brief account which follows is entirely of a preliminary nature. Perhaps the most striking feature of the collection is the great variety of fossil apes which it represents. Before the first discoveries in Kenya, the only certain information available about fossil apes which existed earlier than the Middle Miocene was provided by two fragmentary jaws from the Oligocene of Egypt, *Parapithecus* and *Propliopithecus*. Now, with the accession of all the new material from Kenya, we are faced with such a bewildering variety of Early Miocene apes that it is by no means an easy matter to sort them all out. Much of the material consists of jaws and teeth of an ape considerably larger than *Proconsul africanus* (Hopwood), and in which the relative sizes of the premolars and molars, as well as the cusp pattern of the latter, also show differences. There is little doubt, therefore, that they should be assigned to a different species. To this group belongs the almost complete mandible found on Rusinga Island in 1942, as has now been established by the discovery during 1947 of a portion of the maxilla of the same individual, with the cheek teeth in position. A still larger species is represented by portions of a huge mandible found by the British-Kenya Miocene Expedition at Songhor. This jaw is in some respects more massive than that of many adult male gorillas.

In all these specimens (which provisionally are regarded as constituting several species of the genus *Proconsul*), there are certain characteristic features. The incisors are relatively small in comparison with modern apes, and the symphysial region of the jaw is narrow, the axis of the symphysis tending to be more vertical; the canines are large and there is little definite evidence of any marked sexual difference; the first lower molar is proportionately rather small, the upper molars have a well-developed internal cingulum which in some cases is elaborately beaded, and the lower molars have very evident traces of an external cingulum. Some immature jaws of *Proconsul* which have been found are particularly instructive for the information which they give on the dental succession in these primitive apes. Of similar dimensions to *Proconsul*, but with a very different cusp pattern, are a number of upper teeth found at Rusinga and the surrounding area. These show some resemblance to the teeth of the Middle Miocene Indian genus, *Sivapithecus*, and in the absence of a strongly developed internal cingulum presumably represent a type which is more generalized (or perhaps more advanced) than *Proconsul*. But more material of this type is needed before a definite diagnosis can be made.

Portions of upper and lower jaws of *Xenopithecus* with the teeth in position have now made it possible to make a fairly complete study of the dentition of this genus, and to demonstrate that it differs from *Proconsul* mainly in its smaller size and in the elongation of the last lower molar. Still smaller than *Xenopithecus* is the gibbon-like *Limnopithecus*, of which a number of jaw fragments are now available and also a maxilla and palate with the upper premolars and molars. It now appears probable, from this material, that at least two species of *Limnopithecus* existed in East Africa in the Early Miocene.

Only a few limb-bones of the Early Miocene hominoids have so far been found, but these have provided information of unusual interest. The femur provisionally referred to *Proconsul* is a long, slender and straight bone, very similar to the Eppelsheim femur, which is probably that of *Dryopithecus*. The humerus is likewise of somewhat delicate construction and, though of about the same length as that of an adult chimpanzee, lacks the powerful muscular ridges which are associated with brachiating habits. The talus and calcaneus of *Proconsul* have already been described by McInnes. It is a striking fact that, in many of their details, they conform much more closely to the corresponding tarsal bones of the cercopithecoid monkeys than those of the modern large apes. It is probable, indeed, that *Proconsul* was not a brachiating specialist, but led a more cursorial type of existence. Combined with certain features of the femur, the tarsal bones indicate that these Early Miocene apes were lightly built and active creatures, capable of running and leaping with considerable agility.

These observations will certainly have an important bearing on the problem of the evolution of the higher Primates, for they suggest that the adoption of the brachiating habits which are characteristic of the modern apes may have been a relatively late acquisition. More limb-bone material of the Early Miocene apes of East Africa is needed in order to follow up the very interesting implications of the specimens already available, and we require also to know more about the structure of the skull (which we have

already learned was much shorter in the facial region than in the recent large apes). There is a reasonable prospect that, in continuing their excavations during the coming season, Dr. Leakey and Dr. McInnes may be able to secure this important evidence. Meanwhile, it is not a little remarkable to find, as the result of the excavations in Kenya, that already in Early Miocene times East Africa was populated with numerous species of primitive apes ranging in close gradations of size from small creatures no larger than *Hylobates* to great apes of gorilloid dimensions.

[1] Broom, R., and Schepers, G. W. H., *Transvaal Mus. Mem.*, No. 2 (1946).
[2] Dart, R., *Nature*, **115**, 195 (1925).
[3] Broom, R., *Nature*, **159**, 672 (1947).
[4] Broom, R., and Robinson, J. T., *Nature*, **160**, 153 (1947).
[5] Broom, R., and Robinson, J. T., *Nature*, **160**, 430 (1947).
[6] Hopwood, A. T., *J. Linn. Soc.*, **38**, 437 (1933).
[7] Leakey, L. S. B., *Nature*, **152**, 319 (1943).
[8] McInnes, D. G., *J. East Africa and Uganda Nat. Hist. Soc.*, 17 (1943).
[9] Le Gros Clark, W. E., *Nature*, **160**, 891 (1947).

BRITAIN'S FUEL PROBLEMS

THE authoritative reports issued periodically by P.E.P. (Political and Economic Planning)—an independent non-party organisation—have established for the compilers a reputation for clearly argued, factual and objective analyses to which industry and politicians alike may turn for guidance. Before the War, P.E.P. had issued reports dealing with the coal industry (1936), the electricity supply industry (1936) and the gas industry (1939) of Britain; all are now out of print. But for the War, a fourth report, on the co-ordination of the fuel and power industries, would have followed in natural sequence; and the need for such co-ordination became one of the principal reasons for the formation of the Ministry of Fuel and Power in 1942. "The British Fuel and Power Industries", published at the end of 1947*, reviews developments which have taken place since the earlier reports were issued. It does not argue the advantages or disadvantages of nationalization, and was prepared on the assumption that before long the major fuel industries would, in fact, be brought under national ownership. One aim was to indicate some of the steps necessary to bring these industries to a state of the fullest efficiency, and to suggest broad lines along which their co-ordination might be achieved.

The report invites use as a reference rather than as a book to be read; but an immediate clear summary of some fifty pages outlines the contents in bold précis. As most readers will make an approach from this summary, it might have been helpful had cross-reference been made in it to the 160 tables of valuable data which follow in the text. Both the summary and the text are arranged in four main sections; the first dealing with national resources, productive capacity and output; the second with consumption and market requirements (including a technical appendix relating to the iron and steel and textile industries), the third with organisation and relations with Government, and the fourth with co-ordination of the fuel and power industries.

It is estimated that on the basis of net useful therms supplied, coal accounted in 1945 for more than 90 per cent of the total British fuel consumption, imported petroleum products (including motor spirit) for about 9 per cent, and hydro-electric power and oil from indigenous petroleum and shales for well under 1 per cent. Full development of hydro-electric resources, including those in Scotland and North Wales, might provide an equivalent of 3 per cent of present coal output; the potential output of the Severn Barrage is equivalent to 0·5 per cent. Except for the possibilities inherent in the development of atomic energy, no great change in the proportionate consumption stated is anticipated, unless by an increase in imports of petroleum products at the expense of the country's balance of payments; and while there are no grounds for anxiety regarding the adequacy of total supplies or of particular types of coal over the next hundred years, total proved reserves are much less than estimated forty years ago. No mention is made of possible coal reserves revealed by recent prospecting for oil.

The report indicates that the exhaustion of the best low-ash seams, the increased use of mechanical means of coal winning, etc., call for more extensive preparation of coal for the market, and full co-operation between the producer, consumer and appliance manufacturer; a major problem is the disposal of fine coal, and research and development work are necessary. In view of shortage of coal on the home market, exports have been restricted since 1941; it is debatable whether in the long run large quantities of coal, a wasting asset, should be exported, but coal exports at the level prevailing before the War would make a substantial contribution to the national economy.

With the rapid growth of electricity generation, use of waste heat from power stations represents an important potential contribution to fuel conservation; and while there is scope for greater development of combined power and heating plants, the extensive development of district heating to utilize waste heat from existing power stations is considered economically impracticable. The possibility of district heating should, however, be taken into account in deciding the location of new power stations.

In the iron and steel industry, better geographical distribution and further integration are most likely to reduce fuel consumption. Blast furnaces are the most important single fuel-consuming plants, the coal equivalent of the coke consumed therein increasing from 6 per cent of total coal output in 1937 to nearly 8 per cent in 1944; increase in size of blast furnaces is desirable. In the textile industries, space-heating accounts for 70 per cent of the total fuel consumption in cotton weaving and for 40 per cent in worsted spinning; indeed, the seasonal nature of industrial fuel consumption suggests that the use for space-heating is considerable.

It is stated that a sound national fuel policy can be based only on a detailed knowledge of trends in fuel usage, and fuller information is necessary. Much has been obtained by various fuel efficiency committees and Government departments, but little has yet been collated and published; indeed, there is need for a regular audit of the fuel balance of all industrial users. On grounds of thermal efficiency, the large amount of coal used for steam raising is unlikely to be replaced by any form of processed coal or alternative fuels; in furnace firing, the overall efficiency of utilization of coal is low, and gas, liquid fuel or electricity have technical advantages in partic-

* The British Fuel and Power Industries. A Report by P.E.P. Pp. xi+406. (London: P.E.P., 1947.) 30*s.* net.

ular instances. Solid fuel will be compelled to carry the main load for domestic use for many years to come, if only because in this form sufficient stocks can be provided to meet peak loads; for continuous space-heating of domestic premises, the most efficient appliances are solid-fuel closed or closable fires, and gas fires with convection.

After reviewing technical considerations affecting uses, the report passes to discussion of the possibilities of tariff co-ordination as a means for securing the best use of the national fuel resources of Britain, but without being able to lay down any novel basis. In order that consumers' choice of fuel coincides with national interest regarding resources and smoke abatement, close attention should be paid to the tariff structure of individual fuel supply industries; subject to certain exceptions to cover promotional tariffs and the uneconomical consumer, tariffs should be closely related to cost of production and supply. Special importance is attached to regulation of coal prices; relative prices for various grades and qualities must exert strong influence on trend of consumption and rate of development of the gas and electricity industries. The report recognizes the difficulties involved, and proposes tariff commissions for individual industries, guided by a national authority, probably the Ministry of Fuel and Power; while unrestricted price competition is undesirable, administrative and technological competition has on the whole been of great benefit. There is a serious shortage of fuel technologists and the knowledge of the general public is small.

Even if the report leaves one a little in the air, it is invaluable at the present moment; it will serve for some time as the most readily available guide. Reference may perhaps be made to the remarkable statement on page 131: "the earth's internal store of thermal energy is dependent for its maintenance on solar radiation"; and an omission in discussing possible future trends is reference to the gas turbine, for opinion recently expressed is that the raw coal turbine looks to most engineers a likely practical proposition for industrial service years ahead of atomic energy.

D. T. A. Townend

UNIVERSITY OF PRAGUE SEXCENTENARY CELEBRATIONS

By Dr. GERALD DRUCE

THE six hundredth anniversary of the founding of the Charles University of Prague was celebrated during the week commencing April 4. The precise date of its foundation is usually given as April 7, 1348, the day on which Charles, as King of Bohemia, issued his charter setting out the reasons for the institution of a seat of higher learning in the Czech capital. Until 1355, when the Carolinum was ready, tuition had to be given in religious buildings and in private houses that had previously served as Latin schools. The original building, enlarged and renovated, still serves for important University functions and was used for some of this year's ceremonies. For the general gatherings use was made of the large Vladislav Hall of the Hradčany Castle, which is capable of seating several thousands.

The first assembly was mainly for Czechoslovak participants, and included, as well as members of the University, several Cabinet Ministers, prominent ecclesiastics, authors and representatives of the arts and sciences, workers' educational associations and students. The Czechoslovak Premier, Mr. Klement Gottwald, reminded the assembly that during its long history the University had given the world many great men of science and thinkers and that it entered upon its seventh century at a time of considerable social and economic change from which, it is hoped, a better world is being born. In such a world the University will have a still greater mission to fulfil since more scientific men and other scholars than ever before will be needed.

Prof. Bohumil Bydžovský, rector of the University, dealt at length with the University's significance for the nation's cultural and intellectual life. "For us the Carolinum is a symbol of the struggle for truth and for spiritual and ethical perfection and progress." He stressed the contributions of John Hus and of T. G. Masaryk at different stages of its history. Prof. Z. Nejedlý, Minister for Education and president of the Czech Academy, pointed out that the University has always been associated with national aspirations and its influence to-day is as great as ever, and so are the tasks before it.

Messages of congratulation were given by Profs. Seifert and Ryšavý respectively, on behalf of the sister University of Brno and the Prague Technical College, and by a representative of the students.

On the actual anniversary, the hall was filled with distinguished people and students when the procession of foreign delegates, the rector, members of the Senate, the deans and professors of the Charles University and of the other Czechoslovak universities entered. The rector escorted President Beneš to his seat, welcoming the visitors in short speeches in four languages, referring again to the University's part in the nation's historical evolution. He mentioned its early contacts with other universities, especially those of Paris and Oxford, expressing gratitude to Oxford in particular for allowing Czech students to complete their studies there when the Czech universities were closed in 1939. He expressed his deep regret that British universities and those of some other countries had not accepted the invitations to participate in this historic ceremony.

In presenting the renewed charter, written on parchment by Prof. J. Benda of the School of Fine Arts, to replace the original that disappeared during the German occupation, President Beneš pointed out how moral and political issues profoundly affected the fate of seats of learning, which could always be found on the side of recognized truth, liberty and morality. It was from the University that so many honorable and wise men arose to lead the nation in both glorious and difficult times; but the Charles University had never been able to celebrate its centenaries in peace and tranquillity. Its first centenary occurred when King George of Poděbrady was vainly trying to set up the first league of nations. In 1548 the first Czech revolt against the Habsburgs was being heavily suppressed. The Peace of Westphalia in 1648 followed the Thirty Years War that had devastated and depopulated the kingdom, then in bondage with the University in foreign hands. The year 1748 fell between two more wars that were disastrous for the Czech people, apart from the added contemporary dangers of Austrian measures of centralization and Germanization. Finally, the year 1848, which brought the beginnings of constitutionalism to the Slavs, was also one of storms, and not

even to-day are the celebrations taking place in tranquil times. Three years after the most terrible war in history there is still no such peace as is longed for so ardently. If this human longing, accompanied by freedom of belief, science, thought and profession, is to be fulfilled, President Beneš said, it is even more necessary to realize a universal freedom of the spirit. This freedom, founded on man's respect for man and on the common tolerance traditionally associated with the Charles University, will lead once more to a happy prosperity and a truly happy future.

The preamble in Czech and the Latin text of the renewed charter were read out by Prof. Nejedlý.

Prof. Jean Sarrailh, rector of the Sorbonne, gave a congratulatory address on behalf of the visitors. He referred to the links between Prague and other universities, and mentioned that the Czech scholar, Albertus Ranconis, came from the Charles University to Paris, where he was rector of the Sorbonne in 1355. Educated at Paris, Charles IV had carried French educational traditions back to Bohemia, where Hus was soon to make a stand for religious freedom and social justice. The successful extension of learning was interrupted by the Habsburgs, who even banned the use of the Czech language; and it was not until 1918 that free cultural activities could be resumed at the Charles University. Since then, Czech culture and civilization has become better known in France and elsewhere through the work of Prof. Ernest Denis, who also enabled Czech pupils to attend high schools at Nîmes and Dijon, where Eduard Beneš studied. The development of Czech culture was again interrupted by the German occupation in 1939; but no force can for ever prevail over the spirit, and the University is again happily in Czech hands. Prof. Sarrailh concluded, "Ainsi, comme au Moyen-Age, votre Université remplira son rôle international. Fidèle au grand rêve de Georges de Poděbrady, le plus populaire de vos rois, elle travaillera à l'avènement de la paix universelle et restera le temple de science et de progrès humain qu'avait voulu faire d'elle son fondateur".

A students' representative, M. Grohmann, spoke *extempore* in four languages, before the delegates of foreign universities presented illuminated scrolls to the rector.

On the following day, honorary doctorates were conferred at the Carolinum on about forty distinguished savants representing all branches of learning, including science and medicine. The theological faculty awarded a degree to Cardinal Mercatti, archivist at the Vatican; the medical faculty gave degrees to Prof. R. Leriche of the Collège de France, Prof. L. A. Orbelli of Leningrad and Prof. P. D. White of Harvard. The awards of the philosophical faculty went mainly to specialists in Slavonic subjects, such as Prof. André Mazon of Paris and Prof. Ali A. Siassi, rector of Teheran University. The natural science degrees were conferred upon Prof. P. E. Eskola of Helsinki, Prof. B. Isačenko of Moscow, Prof. S. J. Jakovljević of Belgrade, Prof. L. Růžička of Zurich, Prof. W. Sierpinski of Warsaw and Prof. S. I. Vavilov of Moscow. The only Czechoslovak recipient was the Minister of Education, Prof. Z. Nejedlý, who recalled how he had graduated in the same hall forty-eight years earlier. A number of the degrees were conferred *in absentia*, and Prof. Nesmeyanov, rector of the University of Moscow and well known for his researches on organo-metallic compounds, in accepting them for his absent Russian colleagues, replied for the recipients.

The formal ceremonies of the sexcentenary celebrations terminated on April 9 at the Vladislav Hall. The six deans of the University gave brief accounts of the history and work of their respective faculties, and Prof. Bydžovský concluded by thanking those whose work and presence had made the occasion such a success. It had been a landmark in the history of the University and of Czechoslovak learning, and had served to strengthen the bonds of friendship between men of science and culture throughout the world.

At the Clementinum and in the Industrial Art Museum there were exhibitions of books, historic documents, *incunabulæ*, paintings and other objects that are rarely available for the public to see. These included various fourteenth century Bulls and decrees relating to the University, the original Kutná Hora decree dated 1409 of Wenceslas IV, a letter from the rector in 1414 protesting against the burning of books, fourteenth-century registers of students, the matriculation lists for 1372–73 and a manuscript written by Hus as rector in 1401–2.

The "Letter of Majesty" extracted from Rudolf II in 1609 which conferred greater liberty on the University was on view, and showed the scissor cuts of Ferdinand II, who revoked it in 1620. There were many early scientific tracts, diplomas, and early printed books. Most of the portraits were of early scholars and naturalists such as Mikan, Bohadsch, Procházka, Marcus Marci, Bolzano, Krombholz, the Presls, Dobrovksý and Šafařík. Tycho Brahe's portrait, sextant and "Tabulæ sinuum" were among the other interesting objects on view. The books included the earliest Czech works in science and mathematics, the 1879 edition of Goll's "Development of the English Parliament", which is said to have greatly influenced T. G. Masaryk, and Beneš's 1909 dissertation for his degree ("Developments of Political Individualism in the History of Modern Philosophy"). Among the historical works was the manuscript of Bohuslav Balbin, that waited a century before it was printed as "Bohemia Docta" in 1780. Another curiosity was the 1793 bilingual announcement of Pelcl's lectures (the first to be given in Czech since 1620).

The informal arrangements that followed the official proceedings included excursions to Lány (to see the simple but impressive tomb of President Masaryk and his son, Dr. Jan Masaryk), Lidice, Karlštein (the castle built by Charles IV as a retreat from the cares of State and for the custody of the crown jewels), Kutná Hora and Hradec Králové. It was at Kutná Hora, a medieval mining town and royal seat, in 1409 that Charles's son, Wenceslas IV, signed the famous decree expressly laying down the Czech character of the Charles University. Receptions in connexion with the celebrations were given by the Rector of the Charles University, the Lord Mayor of Prague and by the Minister of Foreign Affairs, Mr. V. Clementis. Mr. Clementis received no less than nine hundred guests in the large reception halls of the Czernin Palace that serves for the Foreign Ministry to-day. A special performance of Smetana's opera "The Bartered Bride" was given at the National Theatre, and the students also arranged some festivities, one anachronistic tableau representing Charles IV riding on a motor-cycle. Unfortunately the strain of the celebrations told upon the sixty-eight years old rector, Prof. Bydžovský, who was taken to hospital two days after the ceremonies ended.

OBITUARIES

Sir Franklin Sibly, K.B.E.

THE life of the late Sir Franklin Sibly was notable as the triumph of a brilliant mind over physical frailty. After an almost precocious career as a student (he obtained the degree of D.Sc. at the age of twenty-five), he became a teacher and worker in geology. He seemed set for the life of an active academic geologist, and the work he accomplished in the ten years of this phase placed him in the front rank. But in 1920 his appointment as principal of University College, Swansea, brought out his latent genius for administration, and during the last twenty-six years of his active life he became successively vice-chancellor of the University of Wales, principal of the University of London and vice-chancellor of the University of Reading. Such responsibilities might well have filled a normal life, especially since their holder was by no means physically robust; but from 1929 until 1946 he held, often concurrently, a series of administrative positions to which he brought qualities of sagacity and geniality beyond the ordinary.

There is no room in this brief account for even a bare enumeration of Sir Franklin's manifold activities; but a few aspects of his achievements may be selected to show something of his qualities. His published geological work is concerned chiefly with the Carboniferous rocks of the Mendip and Forest of Dean districts. After nearly thirty years, his papers still stand as fundamental clarifications of these complex areas—they are by way of becoming classics.

As first principal of University College, Swansea, he achieved a vast amount of constructive administrative work that gave a firm foundation for future developments. As second vice-chancellor of the University of Reading he had further opportunities for building tradition. It was in the last-named office that he spent the longest single period of his life (1929–46), and his colleagues rejoice to realize that the wisdom and friendliness that they found in him were reciprocated in his happiness among them.

In the wider academic sphere, Sir Franklin was chairman of the Executive Committee of the Universities Bureau of the British Empire from 1929 until 1934. Later (1938–43) he held a similar position in the Committee of Vice-Chancellors and Principals, and during the difficult war years exercised a guiding influence on the policy of all British universities.

As a member of the Advisory Council of the Department of Scientific and Industrial Research (for a cumulative period of ten years) he was largely instrumental in devising the conditions of award of the Department's scholarships—now widely recognized as a model for all such schemes. For thirteen years he happily combined both phases of his genius as chairman of the Geological Survey Board.

The honorary degree of LL.D. was conferred on him by the Universities of Bristol, Wales and Liverpool. He was knighted in 1938 and received the K.B.E. in 1943.

In spite of his notable services to British science and also his administrative skill, the abiding memory for those who knew him is one of friendship. His good humour and understanding sympathy were never lacking, even when failing health might have excused their lapse. He improved on the recommendation to be all things to all men by being consistently himself to all; everyone who worked with him or for him knew him for a friend.

H. L. HAWKINS

Mr. G. S. W. Marlow

GEORGE STANLEY WITHERS MARLOW, whose death occurred on March 5, was born in 1889, and educated at New College Choir School, Oxford, and King's College, University of London. He graduated B.Sc. in 1909, and the next year obtained his associateship of the Institute of Chemistry, taking as his special subject, food and drugs. The F.I.C. (now F.R.I.C.) followed in 1913. For a couple of years after graduating, he was assistant to Mr. E. Hinks, public analyst for the County of Surrey. In 1911, he joined the staff of the Government Chemist, where he remained until 1919, when he became assistant secretary of the Institute of Chemistry. After six years there, he left to become personal assistant to Mr. W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers. Meanwhile, in 1923, he had been called to the Bar, and decided to practise in 1927. He was a member of Gray's Inn, and pupil to the late Mr. W. Trevor Watson, K.C. He acted in such cases of chemical patents as arose, his first being the application of Boots Cash Chemists, Ltd., to revoke Sharp and Dohme in the matter of hexyl resorcinol.

In 1926, however, an event happened in Marlow's life which was to transform its pattern to a considerable extent and provide him with a task after his own heart. This was the suggestion by the Council of the Faraday Society that he should succeed the late Mr. F. S. Spiers as general secretary, and take over the management of its affairs, including the editorship of the *Transactions*. Marlow accepted, and in so doing initiated a tenure of some twenty-two years, during which the Society has advanced from strength to strength, largely due to his unflagging efforts, wisdom and guidance. Marlow lived for the Faraday Society, and his devotion to it knew no bounds.

The General Discussions, which have always been the Society's major activity, were a feature before Marlow took charge; but he managed to give them further weight and authority, at the same time enhancing their hospitable and social character. For more than a couple of decades, he always had at least one Discussion ahead, before he was clear of the one behind, and lived, scheming and planning, to make each one an individual success. He would journey to universities all over the country in search of appropriate places at which to meet, and no vice-chancellor or principal was safe from his clutches in his efforts to obtain accommodation and comfortable surroundings for the participants. On these occasions, the guest-night dinners were distinguished, the secretary radiating good-fellowship throughout the evening. During one of these General Discussions, Prof. P. Debye wished to give an impromptu demonstration of the properties of a dipole. Marlow, as to the manner born, quietly handed him a cigar for the purpose. Foreign guests were his special concern; nobody was permitted to worry for a moment on account of lost luggage, money, passports, or even relations. The secretary produced them all, safe and sound, with that engaging smile of his, as if nothing had happened.

So the years went on; the *Transactions* increased in bulk, and—during the War—no less an anxiety

for Marlow, who remained editor until 1946. But above all, they increased in quality until to-day they stand unrivalled in their own field. Marlow worked his referees hard, and they responded.

By nature, Marlow was ever ready to do people or causes a good turn, and this led to his being much in request just perhaps upon the periphery of his normal avocations. He served the Royal Institution as secretary of the Visitors' Committee, and was a manager at the time of his death. His magnanimous but firm reaction to the abortive proposal of that body to revise its by-laws somewhat drastically was characteristic. He was prepared for change, where change was necessary, but not for ruthless pruning of those noble, rounded phrases of which we shall never see the like again. He delighted in them, and all for which they stood.

In recent years, Marlow took much interest in the Society for Visiting Scientists, and would often be found at its headquarters, lending a friendly hand with whatever was afoot. But in all this, the Faraday Society was Marlow, and Marlow was the Faraday Society; wholly impossible was it to think of one without the other. And that, alas, is what in practice we are obliged to do now. Nobody is irreplaceable, but Marlow's life-line had been approaching the asymptote of indispensability for a number of years, and with its end the margin of contact is seen to be exceptionally narrow.

ERIC K. RIDEAL
F. I. G. RAWLINS

Prof. Selig Hecht

THE death of Prof. Selig Hecht in New York on September 18, 1947, at the age of fifty-five, deprives the physiology of vision of one of its most outstanding workers. Hecht was born in Austria and was brought to the United States as a child. He studied and worked in the United States, in England, Germany and Italy. After a broad biological training, he devoted his life to the study of the mechanisms of vision, considered as a branch of general physiology. He became professor of biophysics at Columbia University and made his laboratory an international centre of visual research.

Hecht's main work was concerned with the investigation of the many visual functions in man, such as dark-adaptation, intensity discrimination, acuity and colour vision. He had begun, however, by studying the reaction to light of simple organisms, such as the clam *Mya arenaria*, and he carried out some remarkable experiments on the vision of insects. He also worked on the photochemistry of visual purple. All these researches were inter-connected comparative studies trying to reach the principles of visual response. Hecht's method was quantitative and his experimental standards exacting. The introduction to his lucidly written papers was often a concise but critical synthesis of a mass of literature on the subject, including the early classical work, of which he had an exhaustive knowledge. His aim, he said, was not to add to, but rather to subtract from, the literature on vision.

The leading idea of Hecht's research was that the very first reactions which take place between light and the photo-receptors are bound to determine to a large extent the characteristics of the visual response. He therefore concentrated his attention on these reactions, because they were easier to study than more central processes, especially those in the brain. One result of his work was to establish beyond doubt the duplex nature of the mechanisms of the human retina, corresponding to the division of its photo-receptors into rods and cones. He clarified the relation between the rod visibility curve and the absorption of visual purple, and he devoted much attention to the photo-chemistry and kinetics of the reactions initiated by light in the receptors, introducing the notion of the 'stationary state' of excitation.

Just before the War, Hecht took up with characteristic thoroughness the problem of the minimum energy necessary for vision. He found that a man can see a source of light which delivers to his retina only six quanta or so, absorbed by the visual purple of the rods. Stimuli consisting of such small quantities of light have unique properties; for example, they undergo from one trial to the next uncontrollable variations, which are related to the uncertainty of seeing observed in the measurements.

Hecht worked strenuously on visual research for the American Forces during the War. As he was preparing to return to the study of quantum problems, he died suddenly of a coronary thrombosis.

A painter and a man of discriminating taste, Hecht had many interests. A well-done piece of scientific work would fill him with delight. It was both as a scientific man and as an artist that, for example, he admired Schultze's pioneer work and his drawings of the retina. He was a brilliant lecturer and expositor—he wrote a book entitled "Explaining the Atom". The lack of synthesis discernible in present-day knowledge and teaching perturbed him, and he took an active interest in all the human implications of science. He dealt with persons and ideas on the basis of their intrinsic worth and was always ready to give genuine help, so that he won the affection of all those working with him. Selig Hecht will be mourned by many friends and colleagues throughout the world, and his death is a great loss to science.

M. H. PIRENNE

Prof. M. C. Potter

PROF. N. S. ALEXANDER, Physics Department, Raffles College, Singapore, writes: An interesting link with Victorian science ends with the death at the age of nearly ninety of Prof. M. C. Potter [see *Nature*, April 17, p. 590]. Some time ago, Prof. Potter presented me with a copy of "A Treatise on Hydrostatics and Hydrodynamics" written by his uncle, Dr. Richard Potter, formerly professor of natural philosophy in University College, London. Part 2 of this work was completed in 1880, the author being then eighty-one years of age, and was published by M. C. Potter in 1887. These two lives between them span nearly 150 years.

Richard Potter's book takes one back into the 'caloric' controversy, and his views are sufficiently shown by the following quotations: (*a*) referring among others to Rumford's experiments, "The whole three cases are mills for grinding atmospheric air under pressure with the production of heat from its condensation"; (*b*) "In Mr. Joule's experiments which were performed in air, the effect rising from its presence is entirely neglected, and the phenomena of heat being attributed to the mechanical force applied alone . . . the conclusions drawn from them are erroneous"; (*c*) "c/c' (the ratio of the principal specific heats of a gas) = 1 nearly for small values of δ (the condensation), and the *instantaneous* change

in specific heat of a gas is insensible for small rarefactions and condensations. After some time which has not yet been ascertained, the change in capacity for caloric is completed, and the temperature has changed considerably."

Prof. M. C. Potter had clearly been influenced by these views, and up to the time of his death was endeavouring to show that the usual statement of the First Law of Thermodynamics is incomplete. He had obtained some quite interesting results on electrical effects accompanying various chemical and mechanical changes, and believed that the neglect of these effects constituted a fatal objection to the experimental basis of the First Law. He frequently used to remark, "Joule will have to go". Perhaps it would not be too much to refer to Dr. Potter as the last of the calorists.

We regret to announce the following deaths:

Prof. S. C. Brooks, professor of zoology in the University of California, Berkeley, known for his work on the biological effects of radiations and the permeability of cells, on April 25, aged fifty-nine.

Dr. H. W. Richmond, F.R.S., president during 1920–22 of the London Mathematical Society, on April 22, aged eighty-four.

NEWS and VIEWS

Archæology in the University of London: Dr. R. E. Mortimer Wheeler

Archæologists will be pleased to learn that Dr. R. E. Mortimer Wheeler has accepted a chair in the University of London. He shares with Sir Cyril Fox the distinction of being one of the most stimulating of archæological exponents in Great Britain. Dr. Wheeler has had a distinguished career both in archæology and in the army. For a time he was director of the National Museum of Wales, and then he became head of the London Museum. It was during this London Museum period that Mrs. Wheeler died; to her splendid personality and experienced help he owed much both personally and archæologically; as, for example, when he set about the founding of the Archæological Institute, which is housed in Regent's Park. A member of the Territorial Army, the War sent him to Africa with the 8th Army and Italy with the 5th, where he ended up as one of the small band of non-professional soldiers who achieved the rank of brigadier. Recently, he has been director-general of archæology in India. He has been president of innumerable archæological bodies and has served on the Royal Commission on Historical Monuments. Dr. Wheeler has undertaken not a few archæological excavations, the most important, perhaps, having been that at Maiden Castle, and has published extensively on various subjects. His book "Prehistoric and Roman Wales" is a standard work on early times in that country. He has also written on the ancient sites at Lydney and Verulamium. His influence will greatly strengthen the growing school of archæology in the University of London, and we may look forward to many interesting results from excavations undertaken by him.

Institution of Metallurgists: Dr. A. D. Merriman

Dr. Arthur D. Merriman has been appointed to the full-time post of registrar-secretary of the Institution of Metallurgists. Dr. Merriman's initial training was in physics, mathematics and chemistry, and he has had some twenty years experience in academic fields, including the post of principal of the County Technical School, Wallsend-on-Tyne, 1926–38. During the early part of the Second World War, he served with the Directorate of Scientific Research, Ministry of Supply, and was the senior member of a group of scientific men and engineers dealing with bomb disposal problems; for his personal courage in emergency situations he was awarded the George Cross. From 1941 until 1944 he was scientific adviser to the Commander-in-Chief, Middle East, and in 1944 was appointed to a special intelligence assignment in the U.S.S.R., followed by similar work in north-west Europe and Germany. Since then he has been a principal scientific officer (technical intelligence) at the Armaments Design Department, Ministry of Supply. Dr. Merriman succeeds Dr. Harold Moore, the Institution's first president, who has been serving as registrar, and Mr. K. Headlam-Morley, secretary of the Iron and Steel Institute, who has acted as secretary of the Institution. Office accommodation will continue to be provided for the Institution at 4 Grosvenor Gardens, London, S.W.1.

British Council Science Department: Mr. E. Bolton King

Mr. E. Bolton King, formerly managing director of the Oxford Instrument Co. and during the War a member of the Ministry of Supply Rocket Team, has been appointed director of the Science Department of the British Council. Educated at Warwick School and Balliol College, Oxford, where he was a mathematical exhibitioner, he obtained first-class honours in Physics Finals. He was elected to a research studentship at Christ Church, Oxford, and carried out research at the Clarendon Laboratory, largely on photo-electricity. Later he formed the Oxford Instrument Co. Early in the War he joined the Ministry of Supply Rocket Team under Sir Alwyn Crow and was engaged on rocket development, with special emphasis on proximity fuses, investigation of the performance of British and enemy rocket weapons in the Mediterranean theatre and liaison with rocket development in the United States, where he was an assistant director of the British Commonwealth Scientific Office. At the end of the War he went to Germany in connexion with the British firings of the V-2 rocket and became superintendent of the Ministry of Supply Establishment, Cuxhaven; since then he has been in the Directorate of Guided Weapons of the Ministry of Supply.

Exhibition of the Development of Lighting

A special exhibition, "Darkness into Daylight", was opened at the Science Museum, London, on April 29 to illustrate the development of lighting from the earliest times to the present day. A historical section, in which the Victoria and Albert Museum has co-operated, shows vividly by means of examples and dioramas the growth of lighting until the lamps of Swan in 1878 and Edison in 1879 marked the

beginning of an era of intensive research culminating in modern discharge lamps. Among these, the xenon arc, which has so far been confined to laboratory demonstrations, is exhibited, together with microsecond flash tubes and compact source lamps. The history of fluorescence is covered by an attractive series of demonstrations, and its applications, including that of mine lighting, are also shown. Applications of lighting to the theatre, television, roads and medical uses include many interesting demonstrations, while good lighting in the home is shown by a full-scale sequence exhibit called the "Room of To-morrow". The Exhibition will remain open until the end of September.

Davy Faraday Exhibition in Paris

An exhibition devoted to the life and work of Davy and Faraday has been arranged at the Palais de la Découverte in Paris (which operates in association with the University of Paris) with the close collaboration and support of the Royal Institution, the Institution of Electrical Engineers, and the Science Museum, and will remain open until July. The managers of the Royal Institution have lent a number of the relics of Michael Faraday from their collection, as, for example, some of the original apparatus used by him in his experiments and pieces of his laboratory and office equipment. The Council of the Institution of Electrical Engineers has lent a number of Faraday manuscripts and letters and the full-sized reproduction of the statue of Faraday, the original of which stands on the main staircase in the Royal Institution, which dominated the Faraday Centenary Exhibition at the Albert Hall, London, in 1931. The General Post Office has provided an ingenious working section of an automatic telephone exchange, recently shown at Radiolympia. With the collaboration of the British Council, arrangements have been made for a number of lectures to be delivered at the Exhibition by British men of science and engineers on the life and work of Davy and Faraday.

British Institute of Management

Presiding at the first meeting of the British Institute of Management on April 21, Sir Charles Renold, chairman of the Institute, said that the Institute would need the goodwill, active interest and co-operation of all who exercised the major responsibilities of management. Management, he emphasized, is not concerned with party politics or with theories of ownership, and it is with the principles which apply to all industries and with the problems arising in their application that the Institute is concerned. A national drive for better management would be developed along three main lines: by the compilation of knowledge about management; by promoting education and training facilities; and by the dissemination of knowledge about management. Speaking of the necessary research, Sir Charles hopes that the Institute will have the co-operation of the universities and other bodies, including the trade unions, and he pointed out that there is little or no guiding experience in Great Britain for some of the problems of management presented by the vast scale of some of the nationalized industries. The Institute has already initiated discussions with university authorities on the preparation at the university-level of men for management, and is also studying training for foremen and supervisors. Sir Stafford Cripps, who, as well as Sir Frederick Bain and Miss Florence Hancock, chairman of the Trades Union Congress, also spoke, emphasized the importance of the Institute being wholly free from Government interference and from concern with party politics. While providing a grant-in-aid, the Government is in no way attempting to control expenditure within the broad purposes agreed. The failure of so many production units to attain the high standards of efficiency set by the most skilled and enlightened managements is a cause of many of the present economic difficulties of Britain; but in spite of the great importance of the technical side, the first and overriding requirement is the creation of an atmosphere of trust. Only in that atmosphere can we secure the co-operation of those working in the factories in the difficult adjustments which the new techniques of production often involve.

British Association: Brighton Meeting

The British Association has now issued a preliminary programme of the annual meeting to be held in Brighton during September 8–15, with Sir Henry Tizard as president. At Dundee last year 3,300 people attended the first of the annual meetings to be held after the outbreak of war in 1939, and the theme of the meeting was the conversion of science from the destructive uses of war to the constructive uses of peace. The programme for the Brighton meeting is again topical and of wide general interest. Among the topics to be discussed are: achievements of X-ray analysis; newer metals and alloys in industry; geology to-day and to-morrow; biology in schools; Colonial development; movements of population in the Commonwealth; the metric system; building materials; human blood groups; colour vision; changing aspects of nutrition; selection of university students; problems of old age; aspects of world education; administrator and teacher; maintenance of world food supply; forestry and the community. The programme can be obtained from the Secretary of the Association, Burlington House, Piccadilly, London, W.1.

The presidents of the various sections are as follow: (A) *Mathematics and Physics:* Sir Lawrence Bragg; (B) *Chemistry:* Prof. John Read; (C) *Geology:* Dr. A. E. Trueman; (D) *Zoology:* Prof. H. Graham Cannon; (E) *Geography:* Lord Rennell of Rodd; (F) *Economics:* Sir Hubert Henderson; (G) *Engineering:* Prof. T. R. Cave-Browne-Cave; (H) *Anthropology and Archæology:* Mr. R. U. Sayce; (I) *Physiology:* Prof. H. Hartridge; (J) *Psychology:* Prof. A. Rex Knight; (K) *Botany:* Prof. J. R. Matthews; (L) *Education:* Mr. O. Lester Smith; (M) *Agriculture:* Dr. G. Scott Robertson; *Conference of Delegates of Corresponding Societies:* Prof. H. J. Fleure.

Colonial Microbiological Research Institute, Trinidad

Acting on a recommendation of Sir Robert Robinson and Prof. J. L. Simonsen, who paid a visit to the Caribbean in 1944, the Colonial Products Research Council decided to erect in Port of Spain, Trinidad, a Colonial Microbiological Research Institute. This Institute, of which Dr. A. C. Thaysen, formerly of the Chemical Research Laboratory, Teddington, is the director, will be opened officially on July 5 by Lord Hankey, chairman of the Colonial Products Research Council. Invitations to attend the opening have been sent to Canada, the United States, the Caribbean Commission, and to a number of South American Republics. The opening will be followed on the Tuesday and Wednesday by scientific meetings.

amplitude of the diffuse reflexion (which is not the same as the structure factor for the unit cell of the structure calculated at a point between two Bragg reflexions, as Booth seems to imply) may be complex; and a quantity can change continuously from real and positive to real and negative without anywhere passing through zero if complex values are possible. In practice the amplitudes and phases of the diffuse reflexions are continually changing as the crystal vibrates, and what is observed is the *mean* intensity.

Secondly, the phase-angle of a reflexion is not an absolute quantity, as is often implied; it depends on the position taken for the origin of the unit cell of the structure. For example, consider a simple cubic structure of the KCl type. If we take the origin at one of the atoms, every reflexion has a phase angle of 0°. If, however, the origin is shifted to a point at the centre of the unit cell considered above (this still gives us a centre of symmetry at the origin), then the phase of the (h,k,l) reflexion is 0° or 180°, according as $(h + k + l)$ is even or odd. This shows that one must treat with caution any general argument leading to the conclusion that two reflexions have the same phase angle, since this conclusion may, in some cases, be meaningless.

ALEXANDER R. STOKES

Physics Department,
King's College,
London, W.C.2.
Jan. 14.

[1] Booth, A. D., *Nature*, **158**, 380 (1946).

Extensive Penetrating Showers

AN investigation has been carried out in which extensive showers selected by a fourfold array of Geiger – Müller counters (each of area ~ 200 cm.²) were used to trigger a cloud chamber of collecting area about 70 cm.². In addition, the operation of a large single counter tray (area ~ 720 cm.²), shielded by 15 cm. lead on the top (or in part of the work with 16 cm. iron + 10 cm. lead) and surrounded by 8 cm. lead on all sides, in coincidence with the fourfold array was recorded on the chamber photographs by means of an indicator lamp. Thus a density sample of the showers was obtained in the chamber and the probability of the operation of the shielded tray was studied as a function of the number of shower tracks in the corresponding photographs.

The total fourfold shower counting-rate was found to be $2{\cdot}08 \pm 0{\cdot}08$ counts per hour, of which $0{\cdot}345 \pm 0{\cdot}024$ counts per hour were accompanied by penetrating effects under 15 cm. lead, while $0{\cdot}365 \pm 0{\cdot}032$ counts per hour was the rate of penetrating counts under 16 cm. iron + 10 cm. lead.

Following the treatment described by Jánossy and Broadbent[1], we deduce from these data that the average probability that a single shower particle is accompanied by a penetrating event is $k = 0{\cdot}020 \pm 0{\cdot}002$. The result is in good agreement with those of previous workers.

Assuming the density spectrum of extensive showers given by Cocconi[2], Daudin[3] and Clay[4], we were further able to deduce the expected rate of photographs showing a number n of shower particles. The expression for the fraction of the photographs with n tracks is

$$R(n) = \int_0^\infty (1 - e^{-sx})^4 e^{-s_1 x} \frac{(s_1 x)^n}{n!} x^{-(\gamma+1)} dx,$$

where $\gamma = 1{\cdot}5$ is the integral exponent of shower density, and s, s_1 are the collecting areas of each of the fourfold counters and of the cloud chamber respectively. The calculated values are given in column 3 of the table, and are in agreement with the observed numbers (col. 2).

Now using an extension of this analysis to the penetrating part of the shower, we are in a position to compare the fraction of penetrating counts when n shower tracks appear in the cloud chamber photograph, with that to be expected on a specific assumption about the relationship between the probability of the occurrence of a penetrating count and the local density of the extensive showers. We use here the simplest assumption: that the occurrence of a penetrating count in any region of an extensive shower is proportional only to the particle density in that region; in fact, that the constant $k = 0{\cdot}020$ refers not only to the average over all showers but also in detail over the whole range of shower densities important in this experiment. An expression can be deduced for the fraction f of photographs showing n tracks not accompanied by penetrating counts:

$$f = \frac{\int_0^\infty (1 - e^{-sx})^4 e^{-s_1 x} \frac{(s_1 x)^n}{n!} e^{-s_2 kx} x^{-(\gamma+1)} dx}{\int_0^\infty (1 - e^{-sx})^4 e^{-s_1 x} \frac{(s_1 x)^n}{n!} x^{-(\gamma+1)} dx},$$

where s_2 is the area of the shielded extension. In the table, values of f calculated using this expression are compared with those observed. It is evident that the assumption made about the distribution of penetrating events throughout the extensive showers represents closely the observed results. The table combines data in which the tray of counters, recording penetrating events, was shielded by 15 cm. lead and by 16 cm. iron + 10 cm. lead. No significant difference was found between these two conditions; the implication of the result will be treated in more detail elsewhere.

No. of particles, n, in the cloud chamber	Total No. of showers		Fraction, f, of showers not accompanied by penetrating count	
	Observed	Calculated	Observed	Calculated
0	805	759	$0{\cdot}87 \pm 0{\cdot}01$	0·91
1	342	366	$0{\cdot}83 \pm 0{\cdot}02$	0·85
2–3	206	222	$0{\cdot}75 \pm 0{\cdot}04$	0·75
4–7	57	68	$0{\cdot}54 \pm 0{\cdot}09$	0·52
⩾8	27	22	$0{\cdot}18 \pm 0{\cdot}08$	0·17

I wish here to record my sincere thanks to Prof. Blackett for the encouragement and facilities he has given for conducting this experiment. I am also greatly indebted to Dr. Jánossy for suggesting the problem and helping me in the interpretation of the results, and to Dr. Wilson and Mr. Hamilton for many helpful discussions during the progress of the work.

B. CHAUDHURI

Physical Laboratories,
University of Manchester.

[1] Jánossy and Broadbent, *Proc. Roy. Soc.*, A, **192**, 364 (1948).
[2] Cocconi, *Phys. Rev.*, **70**, 841, 852 (1946).
[3] Daudin, *Ann. de Phys.*, **18**, 145, 217 (1943).
[4] Clay, *Physica*, **9**, 897 (1943).

Mesons of Different Masses

LEPRINCE-RINGUET[1], Powell and co-workers[2], Rochester and Butler[3] and others have found convincing evidence for the existence of mesons with different masses. It seems, therefore, appropriate to emphasize that these experimental facts, which are to my knowledge not yet satisfactorily explained by either of the current meson theories, can be accounted for by a theory I have proposed recently[4]. I have made an attempt here to solve the problem of elementary particles with the help of four-dimensional spaces. My theory involves that electrons, and similarly protons, may exist in instable 'meso-states' as well as in their normal stable state. The theory provides one solution for the meso-state of the electron (meso-electron) and eighty-two solutions for the meso-protons.

The meso-electron has a spin of 1, a magnetic momentum of 1/137 Bohr magneton; its mass can unfortunately not be determined with as much accuracy as was possible for the other elementary particles; however, its value can be given as $(250 \pm 10)\ m_e$. A neutral meso-electron (neutretto) may also exist, the mass of the latter being only slightly smaller than that of the charged particle.

The meso-protons all have spin $\frac{1}{2}$, and we may divide them into two classes, according to whether the quantum number n is even or odd (see *loc. cit.*, equation 13.1.) The circumstance that the proton belongs in class I renders it plausible that the meso-protons of class I are more stable. The masses and magnetic momenta of the first nine meso-states belonging to class I are indicated in the following table:

No.	n	Mass	Magnetic momentum
1	6	$995 \cdot 8\ m_e$	0·0037 Bohr magneton
2	8	$481 \cdot 8\ m_e$	0·0096 " "
3	10	$217 \cdot 8\ m_e$	0·0256 " "
4	12	$94 \cdot 6\ m_e$	0·068 " "
5	14	$40 \cdot 1\ m_e$	0·187 " "
6	16	$16 \cdot 7\ m_e$	0·51 " "
7	18	$6 \cdot 85\ m_e$	1·38 " "
8	20	$2 \cdot 77\ m_e$	3·77 " "
9	22	$1 \cdot 12\ m_e$	10·26 " "

The masses of the smaller meso-protons can be derived in good approximation from the equation

$$m_{MP} = 5720\ \frac{\ln 2\,(1 + \exp n/2)}{1 + \exp n/2}.$$

In principle also neutral meso-protons may exist, with configurations similar to that of the neutron; however, on account of their large negative mass-defects, it is very unlikely that they would be found in Nature.

It seems justifiable to identify the meso-electrons with the ordinary mesons to be found in cosmic ray experiments, which according to the best mass determination[5] have a mass of about $(240 \pm 30)\ m_e$.

From the data collected in the table, we may infer that the first meso-proton might perhaps correspond to the mesons of mass $(990 \pm 100)\ m_e$ observed by Leprince-Ringuet and recently by Rochester and Butler.

The second meso-proton of mass $481 \cdot 8\ m_e$ may be the π-meson of Powell. This particle could disintegrate, on account of mass, charge and spin conservation, into a meso-proton of mass $217 \cdot 8\ m_e$ (No. 3, μ-meson of Powell) and a neutretto. Taking the mass of the neutretto as $250\ m_e$ and assuming that the energy corresponding to the mass-difference of $14\ m_e$ remaining after decay is divided between the two decay products in such a way that both of them acquire equal impulses, the kinetic energy of the $217 \cdot 8\ m_e$ meso-proton will be 3·8 MeV., which would enable the latter to have a range of 500 microns in the photographic emulsion. Powell found for the range of the μ-mesons a value of about 600 microns.

J. BARNÓTHY

Institute for Experimental Physics,
University of Budapest.
Jan. 11.

[1] Leprince-Ringuet, L., and L'Héritier, M., *J. Phys. Radium* (Ser. 8), **7**, 66 (1946).
[2] Lattes, C. M. G., Occhialini, G. P. S., and Powell, C. F., *Nature*, **160**, 453 (1947).
[3] Rochester, G. D., and Butler, C. C., *Nature*, **160**, 855 (1947).
[4] Barnóthy, J. M., Papers of Terrestrial Magnetism, Hungary, No. 2 (1947). See review in *Nature*, **160**, 847 (1947).
[5] Leprince-Ringuet, L., *J. Phys. Radium* (Ser. 6), **2**, 63 (1941).

Stressed Aluminium

IN the course of an investigation on the behaviour of aluminium (purity 99·998 per cent) after the release of compressional stress to which it had been subjected, it was found that immediately after compression, the lattice parameter was increased, but that in course of time it decreased according to an exponential law, finally reaching a value at room temperature which was higher than the equilibrium value. The rate of recovery increased as the amount of cold work, measured by the percentage reduction in thickness, increased; but the final constant value reached was the same for all the compressions investigated. On annealing the material for a suitable period after it had reached the 'metastable' state, the lattice parameter decreased from the metastable to the true equilibrium value.

Back-reflexion photographs showed that after compression, recrystallization took place, the rate of recrystallization increasing as the percentage amount of compression increased. In case of very severe compression, recrystallization occurred rapidly and immediately after the release of the stress.

Foils made by compressing annealed filings of aluminium did not show the same phenomenon. In this case the increased lattice parameter after compression returned in course of time to the final equilibrium value of the powder from which the foils were produced.

When foreign atoms were introduced into pure aluminium, whether these atoms entered the crystal lattice to form an unsaturated solid solution, or a supersaturated solid solution, that is, an ageing alloy, or whether they were distributed along the grain boundaries, they hindered recrystallization and grain-growth in the compressed material to a marked degree.

Filed and polished surfaces were examined in the light of these results. It was concluded that whereas in a filed surface the lattice parameter of the broken surface crystals changed, finally assuming the lattice parameter of the metastable layer to which they were anchored, in a polished surface the metastable state was reached immediately after polishing, and the crystallites, as in the final state of the filed surface, were in a strained condition. The residual stresses remained until the material was suitably heat-treated. Polishing and filing produce the same metastable state in the surface as severe cold-work produces throughout the body of the material.

These experiments and a discussion of the results will shortly be published in detail.

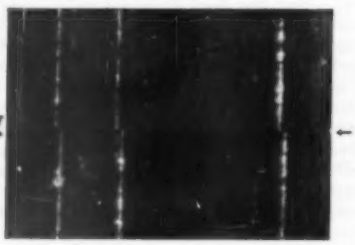
E. A. Owen
Y. H. Liu
D. P. Morris

University College of North Wales,
Bangor. Jan. 8.

Mechanical Behaviour of Crystal Boundaries in Metals

It has been shown by Kê[1] that differences in the mechanical properties of specimens of aluminium with large and small crystal sizes can be accounted for by assuming that the crystal boundaries behave as viscous liquids. Quantitative experimental evidence of the relative movement of neighbouring crystals in a manner consistent with this hypothesis has so far been lacking.

We have made preliminary experiments on specimens of tin consisting of two crystals and one straight boundary, prepared by a method that has been described previously[2]. The specimens were subjected to tensile loading so arranged as to provide a component of shear stress acting on the boundary. When such a stress is applied at a temperature a few degrees below the melting point, progressive relative shear displacement of the two crystals takes place. This movement is observed by means of fine marks inscribed at right angles to the boundary. The accompanying photograph shows a typical specimen after the application of the stress.



Specimen after application of stress (× 10)

As an indication of the magnitudes involved, the following experimental result may be quoted. With a shear stress component of 590 gm./cm.², at a temperature of 222° C., the initial rate of relative movement was 7×10^{-4} cm./hr. Experiments so far carried out suggest that the rate of movement diminishes with time. The maximum displacement so far recorded is 0·1 mm.

If the direction of the shear stress is reversed after the rate has diminished to a small value, displacement takes place in the new direction with considerably increased velocity.

There is evidence that lateral movement of the boundary may occur during the process of boundary slip. It is not clear whether this is an inherent part of the process, or whether it is due to some condition not associated with boundary slip.

R. King

Royal Aircraft Establishment,
Farnborough, Hants.

R. W. Cahn
B. Chalmers

Atomic Energy Research Establishment,
Harwell, Berks. Jan. 19.

[1] Kê, T. S., *Phys. Rev.*, **71**, 544 (1947).
[2] Chalmers, B., *Proc. Roy. Soc.*, A, **175**, 100 (1940).

Internal Stresses in Metals

Heyn pointed out in 1914 that plastic deformation of a metal could result in irregular internal stresses because of the inherent elastic and plastic anisotropy of the grains[1]. With the development of X-ray diffraction methods it has been possible to study the internal stresses by direct experiment. Such X-ray measurements, made by Wood and his co-workers, led, however, to the unexpected result that the internal stresses in a number of metals were by no means irregular, being related in magnitude and direction to the previously applied stress[2]. Iron and carbon steels are typical examples. It was concluded that the stresses were too regular to be explained satisfactorily by the type envisaged by Heyn (which we shall term intergranular stresses).

In a recent communication in *Nature*[3], G. B. Greenough suggests that Wood's results still might be explained by the intergranular stresses if account is taken of the fact that in a given test specimen the X-rays measure the stresses in grains of the same crystallographic orientation only. This property of the X-ray method was pointed out in the above work; but as an explanation of the results it was rejected for the following reason, which further work has confirmed.

Since the intergranular stresses arise from interaction between a grain and its surroundings, the magnitude and direction of the stress experienced by an individual grain will be determined mainly by the relative strength and orientation of its neighbours. The grains of the similarly oriented group which respond to the X-rays are not contiguous but are distributed throughout the specimen. Each grain of the group will be surrounded by a different arrangement of neighbours, and therefore will experience a different internal stress. Further, since on the whole all arrangements of neighbours are possible, the various members of the group taken together will exhibit a whole range of stresses from tension to compression, with a mean stress zero. Therefore the intergranular stresses measured by X-rays will vary at random about a mean zero stress, even though the selection of grains reflecting the X-rays has the same orientation. The regular type of internal stresses, which in contrast are characterized by a mean tensile or compressive stress, according to the experimental conditions, remains unexplained by the intergranular effects.

Indeed, it is difficult to see any manner in which the intergranular stresses could form a systematic system, because the stress-strain curve of a single metal crystal is notoriously structure-sensitive; the behaviour of the grain when part of a polycrystalline aggregate must be even more variable.

We have proved, however, that the intergranular stresses are irregular, even in grains of the same orientation, by experiments on the following lines. If the grain size of a metal specimen is sufficiently coarse, then a random distribution of neighbours for the similarly oriented reflecting grains is impossible. Then the intergranular stresses will not have a mean zero value at the point covered by the incident X-ray beam, but will vary irregularly from point to point in the specimen as different grains reflect. We have made a study of aluminium tensile test-pieces of various grain sizes and found this to be the case. The internal stresses were irregular in magnitude and independent of the different of the previously applied stress, contrary to the suggestion made by Greenough. In such coarse-grained materials, where the inter-

granular stresses are not averaged out, it would be impossible to say whether the regular type of internal stress is present or not.

Further, it is interesting to consider the effect of the intergranular stresses on the X-ray diffraction ring itself. The diameter of the ring depends on the magnitude of the stresses in the reflecting grains; if the mean stress is tension, the diameter will change in one direction, and in the opposite direction if the mean stress is a compression. If, however, the stresses consist of a mixture of tensions and compressions about a mean zero stress, in the manner to be expected from the intergranular stresses in a fine-grained aggregate, then the diffraction ring will broaden radially, but will not change its mean diameter. Now this is the result found for copper. The diffraction ring from a copper tensile test-piece broadens most markedly after plastic deformation, but no appreciable change in the mean diameter occurs; if any change does occur it is masked by the diffusion of the ring and is too small for accurate measurement. In this metal, the irregular type of stress must predominate, although the metal is distinctly anisotropic.

We conclude that two types of internal stress may arise in a metal during plastic deformation: first, the irregular stresses which may be explained by the Heyn hypothesis of anisotropy and inhomogeneities of granular texture; and secondly, the regular type of internal stress which is of special interest because it must be associated in a fundamental manner with the response of the metallic lattice to external stress.

W. A. Wood
N. Dewsnap

Baillieu Laboratory,
University of Melbourne.

[1] Heyn, E., *J. Inst. Met.*, **12**, 3 (1914).
[2] Wood, W. A., and Smith, S. L., *Proc. Roy. Soc.*, A, **182**, 404 (1944). Wood, W. A., *ibid.* (in the press).
[3] Greenough, G. B., *Nature*, **160**, 258 (1947).

If a polycrystalline metal is being extended plastically, the tensile stress in any grain in the metal depends on the orientation of the grain and of its neighbours. When the applied stress is removed, the interactions between grains and their neighbours will result in a complex system of Heyn stresses, the residual stress in any grain being of the same order as the difference in the yield tension of the grain and the average yield tension of its neighbours. The important difference between this concept and that advanced by Wood and Dewsnap is that the latter consider the principal cause of the Heyn stresses to be the variation of the strength of the neighbours, whereas here it is considered that the yield tension of the grain itself is equally important.

Grains of a given orientation in the aggregate have different surroundings, so that the residual stresses in these grains will not be the same after a uniform plastic deformation. However, the mean residual stress, and hence the mean residual strain, in these grains will not be zero, but will depend on the difference between the yield tension of the grain with the given orientation and the average yield tension of the aggregate. It will also be closely related in direction to the original applied tension. The random variation from grain to grain, both in magnitude and direction, about this mean strain due to the effect of the varying surroundings of the individual grains is removed by taking a mean of the strains in a sufficiently large number of the orientated grains in the aggregate. Hence to determine the mean residual lattice strain in grains of a given orientation by observations on the maximum of a diffraction line, the experimental arrangements should be such that many grains contribute to the diffraction line.

The experimental conditions used in the work described previously were such as to ensure that many grains did contribute to each diffraction line. Not only was the grain-size of each specimen so small that enough grains were in the region irradiated by X-rays to give a uniform diffraction ring from the annealed material, but also the results quoted were a mean of the residual lattice strains determined, using at least three different specimens. There can be little doubt that the values of the residual lattice strains are mean values, and that the fortuitous variations in strain due to the varying surroundings of individual grains, although causing a broadening of the X-ray diffraction line, have been eliminated from the results quoted.

While it is considered that the experimental observation of residual lattice strains which represent both compressive and tensile stresses in a plastically extended aggregate is sufficient confirmation of the hypothesis, reference must be made to the success of attempts to interpret the hypothesis in numerical terms. A summary of the results has already been given[1], and it is hoped to publish the work in detail elsewhere. This hypothesis of Heyn stresses appears to give an adequate explanation of the observation of residual lattice strains, and it does not appear to be necessary to postulate any further type of internal stress.

It is interesting to note that the general hypothesis offers some explanation of the recent observation made by Wood and Rachinger[2] on the breadths of X-ray diffraction lines from iron filings and from a plastically extended aggregate. In the former, the stresses in the reflecting grains may have any magnitude and any direction relative to the X-ray beam; whereas in the latter, the stresses have a preferred value, although they show some variation about this value. Hence the variation of the strain in the direction of the reflecting normals in those grains contributing to a diffraction line will be greater in the case of the filings than in the case of the aggregate. One would therefore expect the breadths of the diffraction lines from filings to be greater than that obtained from a plastically extended specimen, if it can be assumed that the broadening is largely due to a variation of strain in the reflecting grains. This is, in fact, the result observed experimentally by Wood and Rachinger.

G. B. Greenough

Metallurgy Department,
Royal Aircraft Establishment,
Farnborough, Hants. Feb. 26.

[1] Greenough, G. B., Inst. of Metals, Mon. and Rep., Series No. 5 (in the press).
[2] Wood, W. A., and Rachinger, W. A., *Nature*, **161**, 93 (1948).

Electrical Breakdown Strength of Air at Ultra High-Frequencies

Difficulties in producing sufficient voltage to break down air gaps at ultra high-frequency have led recent investigators[1,2] to use pulsed magnetrons in order to obtain the high peak voltages that are required. The accuracy of the measurement of the electric stress which is obtained at breakdown in these circumstances must depend on a number of

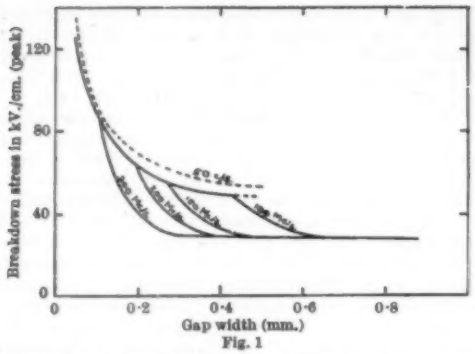


Fig. 1

factors, including pulse width, shape and repetition-rate.

The present series of experiments employs continuous waves throughout, and thereby enables some of the uncertain factors to be eliminated.

A method of measuring the radio-frequency voltage at the point of breakdown has been evolved which relies on the valuable property exhibited by 'Distrene', that its permittivity remains substantially constant over the frequency range 0–1,000 Mc./s. A form of dielectric voltmeter has been constructed which enables calibration to be carried out from a power frequency source.

Throughout the experiments the gap was irradiated by placing a small quantity of mesothorium near it. The effect has been to make the determination of the breakdown stress more precise. Without irradiation it is still possible to obtain the same value of the breakdown stress under given conditions, provided that the voltage has been applied for a long enough time to allow random irradiation to bring about the necessary initial ionization of the gas. A small spark discharge in the vicinity has also been found to give irradiation which leads to the same breakdown stress.

For frequencies in the region of 100–300 Mc./s. and higher, a discontinuity has been observed in the relationship between the breakdown stress and the gap width (Fig. 1). At a critical gap width (which varies with frequency) there is a sudden lowering of the breakdown stress to a constant value of about 28 kV./cm. at atmospheric pressure.

The variation of the breakdown stress at 200 Mc./s. with gas pressure has also been examined (see Fig. 2). It will be observed that the gap width at which the breakdown stress suddenly decreases is practically independent of the gas pressure. This is also true

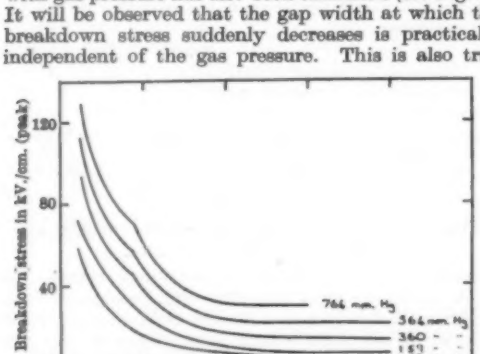


Fig. 2. f = 200 Mc./s.

of the gap width at which the breakdown stress begins to become substantially constant.

These results suggest that, with an alternating field of a particular frequency, some charged particles are unable to cross the gap before the field is reversed. The sharpness of the breakaway would indicate that these particles are, in fact, electrons.

The flat portion would therefore correspond to the condition similar to an electrodeless discharge in which the electrons have space to move without coming into contact with an electrode throughout the time period for which the field remains in one direction.

The theoretical terminal energy U_T of an electron under the influence of an electric stress of E volts/cm. can be shown to be[3]:

$$U_T = \frac{0{\cdot}644\,\lambda E}{\sqrt{\eta}},$$

where λ is the mean free path and η is the fraction of energy lost per impact. From this it would appear that if there is a minimum energy for the electron to initiate breakdown, the corresponding field strength would be inversely proportional to the mean free path (λ) and therefore proportional to the gas pressure. This is, in fact, true of the flat portions of the breakdown stress curve over which the electron can attain its maximum energy (Fig. 3).

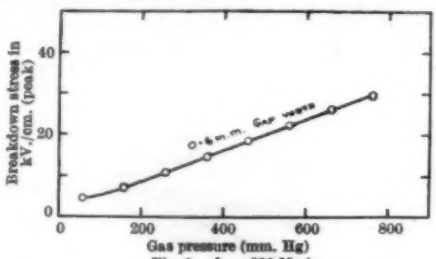


Fig. 3. f = 200 Mc./s.

Further investigations are in progress to examine these phenomena, with the view of establishing, if possible, the mechanism of breakdown for small gap widths.

J. A. Pim

Electrical Engineering Research Laboratories,
University College, London, W.C.1.

[1] *J. Inst. Elect. Eng.*, **94**, Pt. 3 (Sept. 1947).
[2] *Nature*, **161**, 310 (1948).
[3] Loeb, L. B., "Fundamental Processes of Electrical Discharge in Gases", 186.

Magnetic Susceptibility of Borax Glasses Containing Crystallites of Alkali Metal Salts, Gold and Platinum

In two previous communications[1], the results of X-ray diffraction experiments with salts of alkali metals, gold and platinum dispersed in boric oxide and borax glasses have been reported. It has been shown that crystallites of these substances exist in a finely divided condition in these glass media, the size of the particles in the case of the noble metals being somewhat greater than the colloidal particles of these in Zsigmondy's sols, which give only diffuse bands in their X-ray diffraction pictures, as opposed to the sharp lines which I have obtained.

Measurement of magnetic susceptibility of these systems has brought out certain interesting facts. The samples were prepared in the way detailed in

previous communications, and their magnetic susceptibility determined in a magnetic torsion balance (Krishnan and Banerjee[3]). The susceptibility of the dissolved substance was calculated by the additivity formula :

$$100\chi = p\chi_1 + (100 - p)\chi_2,$$

where χ is the mass susceptibility of the sample, χ_1 that of the dissolved salt or metal, p its percentage, and χ_2 the mass susceptibility of the borax.

With the diamagnetic system $Na_2SO_4 - Na_2B_4O_7$, a surprisingly large value of χ for the dissolved salt is obtained, as will be seen from the following table :

Na_2SO_4–$Na_2B_4O_7$–glass system (Majumdar and Banerjee[3])

% Na_2SO_4	$\chi \times 10^6$ (calc.)	$\chi \times 10^6$ for pure Na_2SO_4
8·68	− 1·4389	
10·67	− 1·6428	
13·43	− 1·9394	− 0·337
15·62	− 2·0372	
17·36	− 2·2922	
17·71	− 2·3186	

A set of parallel measurements of the same salt in aqueous solution shows but slight increase in the value of χ for Na_2SO_4, as may be expected.

Na_2SO_4 aqueous solution (Majumdar and Majumdar, unpublished)

% Na_2SO_4	$\chi \times 10^6$
4·73	− 0·3577
7·12	− 0·3631
10·15	− 0·3700
14·30	− 0·3800

With the diamagnetic system $Au - Na_2B_4O_7$, the same increase is noticed, although the increase is not so large as in the previous case.

Au–$Na_2B_4O_7$–glass system (Majumdar and Basu Chaudhury, unpublished)

% Au	$\chi \times 10^6$ (calc.)	$\chi \times 10^6$ for pure gold
0·303	− 0·1512	
1·059	− 0·1528	
1·306	− 0·1538	− 0·1500
1·561	− 0·1552	
1·912	− 0·1574	
2·280	− 0·1604	
3·150	− 0·1682	

The system containing the paramagnetic platinum dissolved in borax glass shows, on the other hand, a decrease in the value of χ of the dissolved metal.

Pt–$Na_2B_4O_7$ glass system (Majumdar and Bhattacharyya, unpublished)

% Pt	$\chi \times 10^6$ (calc.)	% Pt	$\chi \times 10^6$ (calc.)	$\chi \times 10^6$ for pure platinum
0·319	0·9090	1·16	0·7413	
0·57	0·8948	1·41	0·7163	
0·69	0·8841	1·64	0·6359	1·10
1·021	0·8322	1·97	0·3134	

It may be mentioned that gold and platinum are not known to form any borates, and hence cationic exchange in the case of the first system is excluded ; so that the systems may be regarded as consisting entirely of the particles as such, held in suspension in glass.

These results, which in every case indicate an *increase* of diamagnetism of the dissolved particles, can be explained on my view of the effect of the dielectric medium on the lattices of the dissolved crystals[4]. The forces operating within a polar crystal are mainly two, namely, electrostatic forces due to the ions and the short-distance repulsive forces. If a medium possessing a higher dielectric constant is introduced, as is the case when the crystal dissolves in a glass, the Coulomb forces would be diminished and also the short-distance forces, so that a new equilibrium in the lattice will be set up with an increased spacing. This will explain qualitatively the observed increase of diamagnetism of the dissolved crystals. A similar explanation will also hold good for metallic lattices.

The change in magnetic susceptibility on the size of particles has been studied by different workers. But in all cases, such as graphite, colloidal bismuth, antimony, etc., the diamagnetic susceptibility has been found to be *less* than in bulk.

The increase in diamagnetism in the cases studied may be due in part (in the case of the metallic lattices) to the so-called Raman – Ehrenfest binding of the valency electrons. In such a case, the valency electrons have large orbits encircling a relatively large number of atoms ; but it is doubtful if the large increase observed could be explained by such an effect.

My thanks are due to the Indian Association for the Cultivation of Science, Calcutta, for permission to use the torsion balance, and to the Council of Scientific and Industrial Research for a research grant.

SUBODH KUMAR MAJUMDAR
Presidency College, Calcutta.

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Bridge Networks Discriminating between Positive and Negative Sequences in Polyphase Supply

A NETWORK or filter constructed for use with single-phase supply will generally have a different transmission at different frequencies ; a network constructed for use with a three-phase supply has in general a transmission which depends not only upon the frequency of the supply but also upon its sequence.

Fig. 1 shows a bridge network for a three-phase alternating current supply which will transmit a frequency f equal to $1/\sqrt{3}\pi RC$ without change of voltage on condition that the supply has a phase sequence 1, 2, 3. If the phase sequence of the supply is reversed, the output voltage falls to zero. The diagram shows also the calculated transmission curve of the network.

It appears probable that any network which is not the same as its mirror image will show a transmission which changes when the sequence of the supply is reversed. G. B. Madella[1] has shown that the reversal of sequence in the phases of a multiphase supply is correctly thought of as being a reversal in sign of the frequency of the signal. A network may then be expected to have a transmission curve extending throughout the whole frequency range from plus to minus infinity, and the curve will not necessarily be similar in the regions of positive and negative frequency.

The network in Fig. 1 can generate three phases from a single-phase supply if the points 2, 3 and E are made common, and the input voltage applied to point 1, the neutral point and point 2 is in the ratio $1 : 0 : -\frac{1}{2}$. The single-phase supply may then be regarded as the sum of two polyphase supplies of

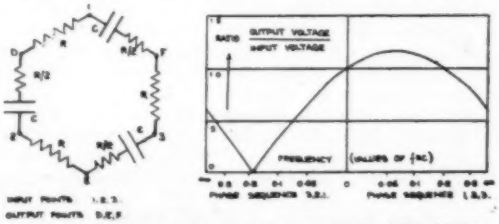

Fig. 1. BRIDGE NETWORK FOR THREE-PHASE ALTERNATING CURRENT SUPPLY, AND ITS TRANSMISSION CURVE

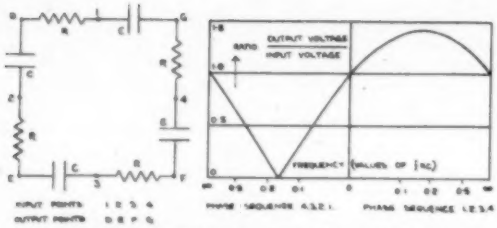

Fig. 2. BRIDGE NETWORK FOR FOUR-PHASE ALTERNATING CURRENT SUPPLY, AND ITS TRANSMISSION CURVE

opposite sequence, and the network transmits one and blocks the other. With this arrangement the impedances between points 2, E and 3 are, of course, omitted, and the arrangement appears as a simple phase-splitting network.

Fig. 2 shows a discriminating bridge for a four-phase supply of frequency f equal to $1/2\pi RC$, together with a calculated transmission curve. If this network is used to generate four-phase supply (or two-phase and neutral) from a single phase, then point 2, the neutral point and point 4 are made common, and voltage applied to points 1, neutral and 3 in the ratio $1 : 0 : -1$. In this case the arrangement becomes a conventional phase-splitting network.

Madella has incorporated his concept of negative multiphase frequency in an improved form of heterodyne wave analyser[2]; he has also shown[3] that the concept gives a full explanation of the action of a modulating filter[4] which has been used in a modified form by D. G. Tucker[5] to give a highly selective transmission measuring equipment. Apart from the greater completeness which appears in the study of multiphase frequency as opposed to single phase frequency the concept seems likely to have considerable technical application and deserves to be more widely known.

N. F. BARBER

Admiralty Research Laboratory,
Teddington. April 16.

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Smoothing Periodograms from Time-Series with Continuous Spectra

IN his review[1] of M. G. Kendall's brochure[2] on oscillatory time-series, David G. Kendall made the pertinent observation that the smoothing of periodograms obtained from autoregressive or other time-series with continuous spectra is equivalent to considering the first few sample autocorrelations. I had arrived at a similar conclusion, though possibly by an alternative route, having noticed that the averaging of periodograms obtained from contiguous lengths of series is approximately equivalent to a truncation of the correlogram at a point represented by the length of the subseries. From preliminary computation already made on M. G. Kendall's artificial series to test out this smoothing device, it appears promising.

In terms of the periodogram intensity $I(\omega)$, standardized to have expectation equal to the variance σ^2 of the series if the latter were entirely random, and related to the correlogram by the identity

$$I(\omega) \equiv \sum_{s=-N+1}^{N-1} C_s \cos \omega s, \qquad (1)$$

where C_s is defined in terms of the observations X_r as

$$C_s = \frac{1}{N} \sum_{r=1}^{N-|s|} X_r X_{r+|s|}, \qquad (2)$$

the (continuous) spectrum of X_r, apart from a factor $1/(\pi\sigma^2)$, is the limit of $E(I)$ as N increases, where E denotes expectation[3]. For M. G. Kendall's series, with autocorrelations ρ_s satisfying $\rho_{s+2} + a\rho_{s+1} + b\rho_s = 0$, $(s \geqslant -1)$, it may be shown that this limit is

$$\frac{\sigma^2(1-b)\,(1-a^2+b^2+2b)}{(1+b)\{1+a^2+b^2-2b+2a(1+b)\cos\omega+4b\cos^2\omega\}} \qquad (0 < \omega \leqslant \pi). \qquad (3)$$

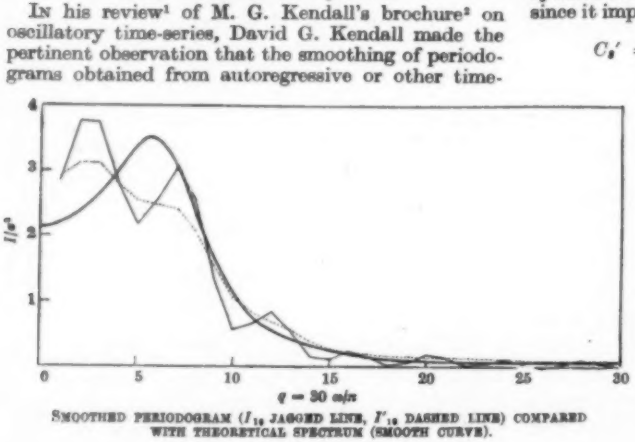
However, in accordance with general spectral theory and as remarked by the late P. J. Daniell, $I(\omega)$ unless smoothed never tends to this limit whatever N, random fluctuations being of the same order of magnitude as the expected value and only the 'resolving power' increasing.

The smoothing procedure first considered was to calculate

$$I_n(\omega) = \sum_{s=-n+1}^{n-1} C_s \cos \omega s, \qquad (4)$$

where n is a submultiple of N, chosen in practice to be a compromise between the averaging power required and the avoidance of bias in the expected value of $I_n(\omega)$. The standard deviation of fluctuations should be approximately reduced by the factor $\sqrt{(n/N)}$ and the bias should remain small if n is still large enough for ρ_n to be effectively zero. A variant of (4) which should be less subject to systematic error, though also rather less convenient since it implies fixing n in advance, is to replace C_s by

$$C_s' = C_s \left(1 - \frac{|s|}{n}\right) \Big/ \left(1 - \frac{|s|}{N}\right). \qquad (5)$$



SMOOTHED PERIODOGRAM (I_{12} JAGGED LINE, I'_{12} DASHED LINE) COMPARED WITH THEORETICAL SPECTRUM (SMOOTH CURVE).

In the diagram the expected intensity (divided by σ^2) is shown for Series 1 ($N = 480$), together with the values of $I_n(\omega)$ computed for $q = 30\omega/\pi = 1 \ldots 30$ and $n = 16$. There is a tendency to systematic oscillation in $I_n(\omega)$, but this is largely eliminated in $I_n'(\omega)$ (corresponding to C_s' in (5)), the values for which are also shown. Even $I_n(\omega)$, however, is a very great improvement over the unsmoothed periodogram, which includes a peak of 12 at $q = 3$ (see M. G. Kendall's Fig. 4.1, where it should be noted that the intensity contains an extra factor of approximately $2/N$ and is plotted against the trial period p, which is $N/8q$).

The arithmetical results also suggested the increase in the fluctuations about the mean as n was increased, but the computation (for most of which I am indebted to Mr. D. F. Ferguson) was carried out with the aid of the serial correlations recorded by M. G. Kendall, and hence was approximate and limited to n less than 48. It is hoped to test out and compare $I_n(\omega)$ and $I_n'(\omega)$ more precisely in due course. For Series 3 ($N = 240$) M. G. Kendall found the unsmoothed periodogram less confusing, owing to the closer approach of this series to an undamped harmonic, but the results for the modified periodogram still suggested an improvement even for n as low as 16.

Two further comments are: (i) this method of estimating the true spectrum could, of course, be improved if the correct form of the autoregressive scheme were assumed, its unknown constants estimated and the corresponding spectrum calculated, but a direct and more empirical estimation of the spectrum will often be required; (ii) the most rapid methods of obtaining spectra for series defined for continuous time avoid computation (for example, employ optical or electrical methods), and it may be possible to arrange for the smoothing to be carried out automatically without the above machinery of the truncated correlogram.

M. S. Bartlett

University of Manchester.
Feb. 13.

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Race, Pigmentation and Colour Vision

Burt[1] has given evidence of a small correlation between darkness of skin pigmentation and colour-vision weaknesses. Vernon and Straker[2] have shown that red-green blindness is more common in the south and west of the British Isles, where the original dark-skinned inhabitants were pushed by the Nordic invaders. Geddes[3] has shown that red-green blindness is less common among the natives of Fiji than among peoples of Caucasian stock. Clements[4] has shown that red-green blindness is less common among American Indians and American Negroes than among American Whites.

Subjects whose colour vision was studied in Glasgow were classified as 'dark' or 'fair' on the basis of skin and hair pigmentation. There were 571 men and women who had colour vision with normal variations of sensitivity, and 138 colour blind and anomalous subjects (not all found by chance) who had major red-green defects which are sex-linked. There was no significant difference between the proportions of dark and fair among the normal and among the red-green defective subjects. The relative frequencies were:

	Normal subjects	Sex-linked red-green defectives
Dark	248	53
Fair	323	85

Protanopes, in whom the red end of the spectrum is greatly darkened, did not have dark skin pigmentation more frequently than deuteranopes. Sex-linked red-green defectives are on the average about ten times less sensitive to these colours than people with normal variations of colour vision. Any tendency for pigmentation to be coupled with major red-green defects in the population sampled in the south-west of Scotland would have been brought out by this experiment.

Among the normal group as a whole no relationship was found between variations in sensitivity to any colour and skin or hair pigmentation. If, however, twenty members of dark-skinned races were taken separately, they were found to have significantly lower sensitivities to blue and yellow (but not to red and green) than the remainder. Of this group, nine who were Dravidians were significantly less sensitive to yellow and blue than Europeans, while six West Africans were significantly less sensitive to these colours than the Dravidians.

It would appear that pigmentation is not associated with loss of colour sensitivity in Britain, except where there is evidence of racial differences. Negroes and American Indians are less often red-green blind than Europeans; but Dravidians and Negroes are more often weak in yellow and blue.

R. W. Pickford

Psychology Department,
University, Glasgow, W.2.
Jan. 18.

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Adsorption of Bacterial Polysaccharides to Erythrocytes

We recently reported that saline extracts of smooth strains of *Hæmophilus influenzæ* (Type *b*) contain a substance adsorbable to erythrocytes[1]. Cells treated with such extracts are agglutinated by type-specific antisera. A sample of the type-specific polysaccharide, prepared by the method of Dingle and Fothergill[2], absorbed from immune sera their power of agglutinating erythrocytes so sensitized, but was not itself capable of sensitizing them. We concluded, therefore, that the fraction in saline extracts which was adsorbed to erythrocytes was a combination of the type-specific polysaccharide with some other substance.

Further work has shown that the assumption of another substance in combination is unnecessary. The sample of polysaccharide employed had apparently been degraded during preparation. Influenzal polysaccharide has since been prepared by extraction with 90 per cent phenol[3,4]. The phenol-insoluble, water-soluble fraction of the organisms contains the type-specific polysaccharide in an undegraded state in which condition it is adsorbed to the red blood corpuscle. If this undegraded polysaccharide is treated with dilute acid or alkali (0·01 *N* or less), it loses successively, first, the capability of being adsorbed to erythrocytes; secondly, the property of precipitation with antibody; and thirdly, the power of combination with antibody. The second and third of these changes have been shown by Morgan to occur during the hydrolysis of the polysaccharide of *B. Shiga*[5], and we have found that the undegraded Shiga polysaccharide is, like that of *H. influenzæ*, adsorbed to the surface of erythrocytes which then become agglutinable by Shiga antisera.

We have, so far, prepared polysaccharides which are adsorbed to erythrocytes from strains of *H. influenzæ*, *Meningococcus*, *Staphylococcus* and *Salmonella typhi*, *derby*, *typhi murium* and *pullorum*. Similar polysaccharides have been obtained from *Pneumococcus* and *B. proteus* by Dr. J. L. O'Connor, and from *Streptococcus* by Mr. P. L. Bazeley, of these Laboratories. The relationship of these polysaccharides

to recognized antigens and haptenes is being explored. This preliminary note is forwarded because we have found erythrocytes coated with bacterial polysaccharides to be useful reagents in various immunological procedures.

Our present technique is to add one volume of packed washed human or fowl erythrocytes to ten volumes of polysaccharide solution (0·1 per cent). The sensitized cells are then washed twice and resuspended in normal saline in 5 per cent concentration. One volume of the suspension of sensitized erythrocytes is added to ten volumes of graded dilutions of antiserum, and the presence or absence of hæmagglutination is noted. The polysaccharide antibody content of sera may be rapidly estimated by this procedure, and the polysaccharide content of solutions can be determined by their ability to inhibit such hæmagglutination. We have used these methods for estimation of the protective antibody in rabbit antisera for treatment of influenzal meningitis, and to determine the polysaccharide content of the cerebrospinal fluid of patients suffering from this disease.

E. V. Keogh
E. A. North
M. F. Warburton

Commonwealth Serum Laboratories,
Melbourne, N.2.
Jan. 12.

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An Adaptation Mechanism of the Organism to Damage: the Role of 'Resistine'

We have shown by experiments on rats and mice, using the Indian ink method devised by Jancsó[1], that the exposure of the organism to various damaging stimuli (injection of formaldehyde, adrenaline, agmatine, exposure to cold, X-ray irradiation, starving, surgical trauma, etc.) leads always to local and often general release of histamine. The site of histamine liberation looked as if it had been painted with Indian ink.

Though the shortening of the time of circulation of the intravenous injection of Indian ink solution (and according to Jancsó's observations that means histamine release, because the histamine is an effective activator of the whole reticulo-endothelial system) did not indicate *in vivo* histamine liberation because of the shock developed at the same time, the increased activity of the reticulo-endothelial system stimulated by released histamine could be detected in our perfusion experiments on surviving rat liver even in the stage of shock. 60–70 per cent more Indian ink was picked up during 40 min. from the perfusion solution by the surviving liver of the rat exposed to damage in comparison to the surviving liver of a normal rat.

It could be shown further that the histamine liberated by certain damage (what might be considered as a 'common pathway' in the adaptation mechanism) brings about as a basic factor all the changes characteristic of the alarm reaction[2,3,4], causes shock and plays also an essential part in setting in operation the defence mechanism of the organism, resulting finally in acquired increased resistance. In the stage of resistance, the Indian ink injected intravenously circulates in the blood significantly longer—about twice as long as in normal control animals. The prolongation of the circulating time is particularly pronounced when the resistant animal is investigated after having been exposed anew to damage. The results obtained in further experiments on resistant animals, when the surviving liver was perfused with Indian ink for 40 min., are in accordance with these findings. The amount of Indian ink absorbed during that time was 25 per cent less than that absorbed by the surviving liver of normal control animals. The absorption of Indian ink was especially diminished (more than 50 per cent decrease compared with the normal liver) when the animal has been again exposed to damage just prior to the perfusion experiment. Similar results were obtained with normal rats treated with antihistamine (Antistine s. Ciba or the preparation of Halpern 3277).

From these observations it seems clear that the increased resistance of the organism is caused by an excess formation of a substance possessing antihistamine activity. Since this substance, formed in the organism by its own cells, is responsible for the acquired increased resistance, it has been called by us 'resistine'. The antihistamine activity of resistine produced in great amount and stored in the organism will be apparent particularly when needed, that is, when the resistant organism has to face further damage.

Experiments concerning the chemical nature of resistine, the mechanism of its formation and its patho-physiological importance, other than the role of rendering the organism resistant, are already under way.

S. Karády
A. Kovács

Department of Internal Clinic
and Pharmacology,
University, Szeged,
Hungary.

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Two Examples of Sera Containing the Anti-*d* Agglutinin Predicted by Fisher and Race

Two sera which have been shown to contain the anti-*d* antibody have been referred to us by Dr. E. E. Dilworth of Shreveport, Louisiana, and Drs. J. W. Davenport and Bruce Everist of New Orleans, Louisiana. The first case, an iso-immunized mother of type *CDe/CDe*, produced a high titre of anti-*c* agglutinin which was greatly increased by the administration of small doses of *cde/cde* cells. Studies of the antibodies produced during this programme of stimulation showed the development of an anti-*d* antibody demonstrated by agglutination with *CDe/Cde* red cells. The second serum was also from a mother of genotype *CDe/CDe*. Fortunately the serum from this iso-immunized mother contained an anti-*d* agglutinin active with saline suspensions of red cells, while the anti-*c* antibody present at about equal titre did not react with saline erythrocyte suspensions but could be demonstrated with the Coombs (developing) test or with a

suspension of erythrocytes in albumin. Using the classical test-tube method with saline suspensions of test erythrocytes, this serum agglutinated cells of the following genotype: *CDe/cde*, *cde/cde* and *CDe/Cde*, but failed to agglutinate cells of genotype *CDe/CDe*, *(?De/CDe*, *cDE/cDE* and *CDe/cDE*. However, when the Coombs anti-human globulin method[1] was used to detect the antibodies, all erythrocytes containing the *c* antigen and/or the *d* antigen gave positive tests. The same results could be obtained by using albumin suspensions of erythrocytes by the method of Diamond and Denton[2]. Further agglutination studies ruled out any correlation with *A*, *B*, *M*, *N* or *P*. The possibility of the agglutinins present in these sera being identical to the anti-Kell[3], anti-Lutheran[4] and anti-Lewis[5] agglutinins was also ruled out by parallel tests with sera supplied by Mourant and Race.

To check further the identity of the agglutinin thought to be anti-*d*, the hæmolytic activity of the serum was studied by techniques previously described[6,7]. These studies showed an equivalent amount of hæmoglobin released at the end of 48 hours from cells of genotype *CDe/cDE* as compared with cells of genotype *CDe/Cde*. On the other hand, cells with antigens determined by a single gene dose of both *c* and *d* showed hæmolysis equal to the sum of that produced by the action against the cells containing one gene dose each of *c* and *d* respectively (*CDe/cDE* and *CDe/Cde*). These results not only seemed to confirm the identity of the anti-*d* and anti-*c* antibodies of the serum, but also revealed a unitary relationship between gene, antigen determined thereby and the amount of hæmolysis produced by the action of the corresponding antibody in the presence of complement.

Since Fisher has predicted a specificity of 64·43 for the anti-*d* agglutinin, it is of interest to note that the closely agreeing specificity of 65·16 per cent was obtained for the anti-*d* agglutinin of this serum when tested against 155 random blood samples of the white population. Furthermore, when the reactions were compared with those of anti-*D* serum, an antithetical relationship was found similar to *M* and *N*, as well as *c* and *C*.

In using the anti-*d* agglutinin, it was noted that certain genotypes could be resolved further. For example, type *CDe/Cde* could be differentiated from *CDe/CDe*. Likewise, *cDE/cDe*, *cDE/cdE*, *CDe/cDE*, *CDe/cdE* and *cDe/cde* could be demonstrated. Obviously family studies are still required for some genotype differentiations, for example, *Cde/cDe*. Efforts to produce usable quantities of the anti-*d* agglutinin by intentional stimulation are now under way.

JOSEPH M. HILL
SOL HABERMAN

Wm. Buchanan Blood Center,
Baylor Hospital and
Southwestern Medical College,
Dallas, Texas.
Jan. 14.

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Fibrinokinase and Fibrinolytic Enzymes

CONFUSION has arisen concerning the terminology of the fibrinolytic enzymes and pro-enzymes contained in blood plasma. In our papers on the fibrinolytic activator contained in tissue cells[1,2], we adhered to the nomenclature used by Loomis, George and Ryder[3], which is adequate from a biochemical point of view, and which has also been used recently by Guest, Ware and Seegers[4] and by Goldhaber, Cornman and Ormsbee[5].

Since the appearance of the paper of Ferguson[6] on the nomenclature of parenteral proteases, we have discussed the problem several times, especially with the group working under R. G. MacFarlane at Oxford[7], who use the nomenclature introduced by Christensen and MacLeod[8].

The major objection to the terminology of Loomis *et al.*[3] is that it does not avoid confusion with the term 'fibrinolysin', when used in its old sense as a substance originating from streptococci. This term is still being used by bacteriologists and serologists (immune antifibrinolysin). The term 'plasmin' for the active enzyme (Christensen[8]) suits all cases, as it is specific for the plasma enzyme and pro-enzyme.

The whole problem of terminology was discussed recently at the Conference on Blood Clotting and Allied Problems held in New York, February 16–17, 1948, under the auspices of the Josiah Macy, Jr., Foundation. No final agreement was reached, but it was recommended that authors should use both terms in the title and introduction of a paper in order to avoid confusion in abstracting and indexing.

The following observations may be added to those already published[1,2].

Fibrinokinase from pig's heart is completely devoid of action on chicken fibrinogen and fibrin. After incubating this pig fibrinokinase with ox pro-enzyme, a solution results with a powerful lytic action on chicken fibrin. This shows the specificity of the fibrinokinase and its properties as an activator for a proteolytic enzyme.

While the pro-enzyme present in ox serum will yield powerful solutions of enzyme after incubation with fibrinokinase from different tissues and animals, it is not activated by streptokinase. On the other hand, fractions of human serum containing pro-enzyme often yield very active solutions with streptokinase, but are activated to a far less extent by fibrinokinase even after repeated treatments. Such a solution, which cannot be increased further in potency by means of fibrinokinase, will upon addition of streptokinase develop a considerable amount of new activity. Thus there seems to be present in ox serum only one pro-enzyme, which is activated by means of fibrinokinase. In human plasma two pro-enzymes seem to be present, one of which is activated by fibrinokinase, and one by streptokinase. In order to distinguish between two such pro-enzymes and enzymes and in order to avoid confusion, we propose the terms: '*s*-profibrinolysin (*s*-plasminogen)' and '*f*-profibrinolysin (*f*-plasminogen)' for the two pro-enzymes which are activated respectively by streptokinase and fibrinokinase.

We have compared the fibrinokinase activity of normal tissues with that of malignant tissues. The results have so far been variable, showing that the activity often, but not always, is higher for the malignant tissue than for the corresponding normal tissue. An interesting case was encountered in which

the primary tumour showed considerable activity, while a metastasis in the liver was just as inactive as normal liver tissue.

Finally, it may be mentioned that the thrombin *B* [9] used was found to contain a small amount of pro-enzyme which could be removed by extraction of the thrombin with 0·45 saturated ammonium sulphate and precipitation by adding solid ammonium sulphate (cf. Milstone[10]).

TAGE ASTRUP

Banting and Best Department of Medical Research, University of Toronto.

PER M. PERMIN

Biological Institute, Carlsberg Foundation, Copenhagen.

Feb. 23.

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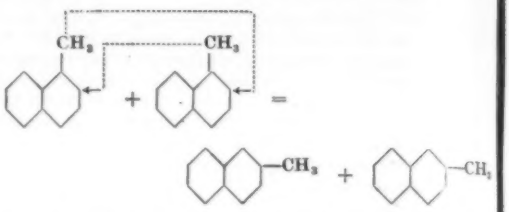
Mechanism of Substitution in the Naphthalene Nucleus

SUBSTITUTION in the naphthalene nucleus appears to occur initially at the α-position, while under more vigorous treatment an increasing proportion of β-substitution is observed; this tendency has been noted in alkylation by the Friedel-Crafts method by Roux[1] and by Tzukervanik and Terentieva[2]. We have found that by passing methyl alcohol and naphthalene vapours over catalysts of the alumina-silica type at 450°, β-methylnaphthalene and dimethylnaphthalenes are formed but not α-methylnaphthalene.

The suggestion that methylation first occurs at the α-position is supported by the results obtained when α-methylnaphthalene is passed over the catalyst at 450°. The initial material is completely transformed, yielding the β-methyl isomer as the main product, with smaller amounts of naphthalene and dimethylnaphthalenes.

As this transformation takes place in the gaseous phase, the methyl group doubtless migrates as a neutral radical. Moreover, there is evidence that the radical moves to a foreign nucleus[3]; for if the rearrangement were intramolecular, the formation of naphthalene and dimethylnaphthalenes would not be accounted for. It is possible that cleavage of the methylnaphthalene molecule to naphthalene and olefin takes place as a side reaction; but the formation of olefin cannot be an intermediate stage in the process: for in such a case, if the ethylene produced reacted with the naphthalene, ethyl, not methyl, derivatives would be formed. It is suggested, therefore, that an interchange of methyl groups between two molecules of α-methylnaphthalene occurs, the methyl group in the first molecule migrating to the β-position in the second molecule, while the methyl group in the second molecule moves to the β-position in the first molecule, thus:



The formation of naphthalene and dimethylnaphthalene would be accounted for as follows:

$$2C_{10}H_7CH_3 = C_{10}H_8 + C_{10}H_6(CH_3)_2.$$

Experimental details of this work will be published elsewhere.

N. M. CULLINANE
S. J. CHARD

Tatem Laboratories, University College, Cardiff.

Jan. 5.

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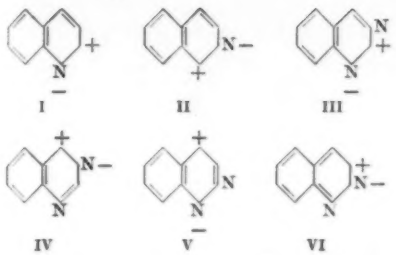
Nitration of Simple Heterocycles

TWO results of interest in the study of comparative heterocyclic chemistry have been reported recently. Nitration of 4-hydroxyquinoline is said to give *c.* 50 per cent of 3-nitro-4-hydroxyquinoline[1], whereas quinazoline provides not less than 56 per cent of the 6-nitro-derivative[2]. In identifying the product from 4-hydroxyquinoline, the authors[1] depended on (*a*) the proved difference of its 4-chloro-derivative from 5-nitro-4-chloroquinoline, its assumed difference from 8-nitro-[3] and 6-nitro-4-chloroquinoline[3], and (*b*) the assumed identity of the derived aminoquinoline, m.p. 94°, with 3-aminoquinoline[4]. We find that the chloro-derivative of the chief nitration product gives a strong mixed melting point depression with genuine 3-nitro-4-chloroquinoline[5]. Further, whereas the former may be crystallized from methanol, such treatment hydrolyses the latter. By analogy with 4-hydroxycinnoline[6] and 4-hydroxyquinazoline[7], we expected kynurin to give chiefly 6-nitro-4-hydroxyquinoline on nitration. In fact, the nitro-chloroquinoline, m.p. 144–145°, prepared as described by Mosher *et al.*[1], gave no melting point depression on admixture with genuine 6-nitro-4-chloroquinoline, m.p. 144–145°[3]. The derived 4-phenoxy-compounds, m.p. 117–118°, were also identical (found for genuine 6-nitro-4-phenoxyquinoline: C, 66·6; H, 4·0; N, 11·4; $C_{15}H_{10}O_3N_2$ requires C, 67·6; H, 3·8; N, 10·5 per cent).

With regard to quinazoline, we have obtained additional confirmation for the orientation of the main nitration product by converting it to 6-chloroquinazoline, m.p. 142–143°, identical with the compound prepared by Riedel's method[8] from 2-nitro-5-chlorobenzaldehyde (found: C, 58·4; H, 3·3; $C_8H_5N_2Cl$ requires C, 58·4; H, 3·1 per cent).

The theoretical interest of the last result is considerable. In the cases of quinoline and *iso*quinoline, both simple resonance considerations of structures of types I and II, and semi-quantitative molecular orbital treatment[9] are in agreement with experiment in predicting formation of 8-nitroquinoline and 5-nitro*iso*quinoline. But they do not explain why in quinoline C_8, and in *iso*quinoline C_7, are by-passed



I II III

IV V VI

in favour of C_8 and C_6 respectively. Steric effects at these positions are not easy to visualize, and in the quinoline C_8 position at least, the adjacent bonds are similar to those around the acridine C_9 atom, a position which is attacked in nitration[8]. For quinazoline and cinnoline no quantitative calculations have been made, but the qualitative picture in the first case, based on structures of type III and IV, leads us to expect nitration at C_8 and C_6. This is partly borne out by experiment, and it remains to be seen whether the 8-isomer can be detected in the nitration product. For cinnoline, whereas structures V would lead to nitration at C_8 and C_6, the inclusion of types VI would produce deactivation at these positions also. However, since N_1 appears to be the basic centre[10], C_8 and C_6 are the probable points of attack.

It is clear that no adequate explanation of nitration orientation in heterocycles has yet been given, even if we leave aside the variations produced by different reagents[11].

K. Schofield
T. Swain

University College of the South West,
Exeter. Jan. 21.

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Electrokinetic Potential and Surface Structure of Barium Sulphate

While there are many investigations on the influence of electrolytes on the electrokinetic or ζ-potential of solids, very few authors have considered the relation between the ζ-potential and the structure and composition of the solid itself. This is partly due to the fact that in many systems the potential-determining ions are foreign to the solid.

We are at present investigating the ζ-potential of sparingly soluble ionic solids such as barium sulphate against their saturated solution by the streaming potential method. In this case, the potential-determining ions originate from the solid. Precipitated barium sulphate is unsuitable for investigation, because the validity of the electrokinetic equations is limited to systems in which the diameter of the 'pores' of a plug is greater than the thickness of the electric double layer. We therefore prepared larger crystals (up to 2 mm.), which could be ground afterwards to any desired size, by recrystallizing barium sulphate from hot concentrated sulphuric acid and subsequent ignition. The following results are typical:

	ζ in mV.
Recrystallized barium sulphate, sample 1	+ 24·2
Recrystallized barium sulphate, sample 3	+ 25·0; 24·3
Recrystallized barium sulphate, sample 4	+ 26·6; 27·1
Natural barite, sample *B*, ignited	+ 5·4; 5·3
Natural barite, sample *C*, ignited	+ 8·4

In spite of the fact that during preparation of recrystallized barium sulphate there was always an excess of sulphate ion, the potential is *positive* and well reproducible within 1 mV. for each sample. The ignition temperature (500–1,000° C.) has no influence on the potential. Most electrolytes change the potential reversibly at room temperature; barium salts increase it, sulphates decrease it; but when, after treatment with the electrolyte solution, the potential is then measured against a saturated barium sulphate solution, the original value is always obtained. This value must therefore be regarded as a property of the sample. This behaviour is shown both by recrystallized barium sulphate and natural barite.

There is, however, a striking difference between the high potential of recrystallized barium sulphate and the much lower potential of natural barite. Spectroscopic analysis of our samples revealed that natural barite contains strontium and traces of calcium as impurities. However, these impurities cannot be responsible for the difference in potential. We incorporated such impurities into the recrystallized barium sulphate (during recrystallization); but, as a result, the potential was slightly increased, never decreased. Moreover, when natural barite is recrystallized from sulphuric acid, a high potential (27 mV.) is obtained.

These and similar observations, which will be discussed in more detail elsewhere, lead us to the conclusion that the difference in potential between recrystallized barium sulphate and natural barite is not due to a difference in composition. The most likely cause is a difference in structure (geometrical or otherwise) of the surface. Natural barite, even after crushing, has even crystal surfaces, whereas recrystallized barium sulphate has very irregular surfaces. This is shown by an investigation in an optical as well as in an electron microscope (for the latter we are indebted to Dr. A. L. G. Rees and Mr. A. J. Hodge of the Division of Industrial Chemistry of the Council for Scientific and Industrial Research). It is likely that the field of force is less well balanced in an irregular surface than in an even one.

Bikerman[1] suggested that the ζ-potential of a rough surface should be different from that of a smooth one for purely geometrical reasons. However, the distortion of the field of force in the surface as a factor influencing the electric potential at a surface is a somewhat unfamiliar concept in the field of electrokinetics. Nevertheless, besides our own observations, there are several findings of other investigators[2,3] which suggest that the ζ-potential of a crystalline solid is not solely determined by the composition of the system.

A. S. Buchanan
E. Heymann

Chemistry Department,
University of Melbourne,
Melbourne.

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INHIBITION OF SH ENZYMES BY METHYL BROMIDE

By S. E. LEWIS

Pest Infestation Laboratory, Slough, Bucks

THE high toxicity of methyl bromide to man, and the insidious character of its action, particularly at low concentrations, were not realized when this compound was first introduced as a fumigant and as a fire-extinguishing agent, but are now well established and have been emphasized in a pamphlet recently issued by the Home Office[1]. Yet its mode of action has remained obscure. It has been frequently suggested that this action results from an accumulation of the products of hydrolysis[2,3], but the experimental evidence does not support this view[4], unless the hydrolysis takes place intracellularly[5]; a theory which would not explain the close parallelism between the symptoms of poisoning by methyl bromide and methyl chloride[6,7].

During an investigation carried out at this Laboratory on the nature of the bromide residue in wheat flour fumigated with methyl bromide, it became apparent that the protein fraction of the flour was mainly responsible for the sorption and decomposition of the methyl bromide[8,9]. Other workers have shown that when aqueous suspensions of wool, silk fibroin, collagen and gelatin are treated with liquid methyl bromide, methylation of carboxyl groups and peptide linkages occurs[10,11]. Similarly, the SH groups in bisulphited wool are readily methylated by such treatment, and S-methyl-cysteine has been isolated from the hydrolysate[12].

In order to determine whether these reactions occur when methyl bromide is present in low concentrations, buffered solutions of cysteine and reduced glutathione were exposed to methyl bromide vapour for periods up to four hours. Oxidation was eliminated so far as possible by exposing the solutions in an atmosphere of nitrogen, or by the addition of cyanide. The number of SH groups remaining after treatment was determined by the reduction of ferricyanide[13], and the ionizable bromide, resulting from the decomposition of methyl bromide, by the method of Kolthoff and Yutzy[14]. The results in Table 1 show that there is a progressive decrease in the number of SH groups and a corresponding increase in the non-volatile bromide in the solutions. Similar tests with oxidized glutathione showed no such increase in the bromide content of the solutions. This suggests therefore that, under the conditions described above, methyl bromide reacts preferentially with the SH group.

The most probable reaction is:

$$R\text{—SH} + CH_3Br \rightarrow R\text{—S—}CH_3 + HBr;$$

and on this assumption the bromide content of the solutions, to be expected as a result of this reaction, has been calculated from the decrease in the number of SH groups (Table 1). The fact that more SH groups have reacted than can be accounted for by the bromide determined is probably due to some oxidation during the exposure or subsequent manipulation. Similarly, when solutions of reduced keratin, prepared by the method of Goddard and Michaelis[15], were exposed at *p*H 7·5 to methyl bromide at a concentration of 400 mgm. per litre, there was a progressive reduction of the strong nitroprusside reaction given by this protein. After two hours exposure, the reaction was almost completely abolished. It appears therefore that, although methyl bromide can react with a number of groups in protein molecules, under the conditions of these tests the reaction with SH groups is particularly rapid.

TABLE 1

	Time of treatment (min.)	Concentration of methyl bromide vapour (mgm./litre)	Mgm. of SH compound reacted	Non-volatile bromide (mgm. Br')	
				Determined	Calculated
Cysteine hydrochloride 25° C. *p*H 7·0	60	400	2·1	0·93	1·06
	90	380	2·75	1·26	1·40
	240	360	4·0	1·85	2·03
Cysteine hydrochloride 37·5° C. *p*H 7·4	30	114	1·7	0·67	0·86
	120	106	3·75	1·45	1·80
	240	98	5·0	2·00	2·55
Glutathione 37·5° C. *p*H 7·4	20	200	0·6	0·135	0·151
	40	200	1·0	0·202	0·270
	80	200	1·45	0·380	0·380

The toxic action of a number of substances has been attributed to their ability to inactivate enzyme systems in the body by combination with SH groups in enzyme molecules. The work of Peters and his co-workers on the inhibition of brain pyruvate oxidase by arsenic compounds affords a particularly good example[16]. The toxicity of methyl bromide might similarly arise from its capacity for reacting with protein SH groups under physiological conditions of temperature and *p*H.

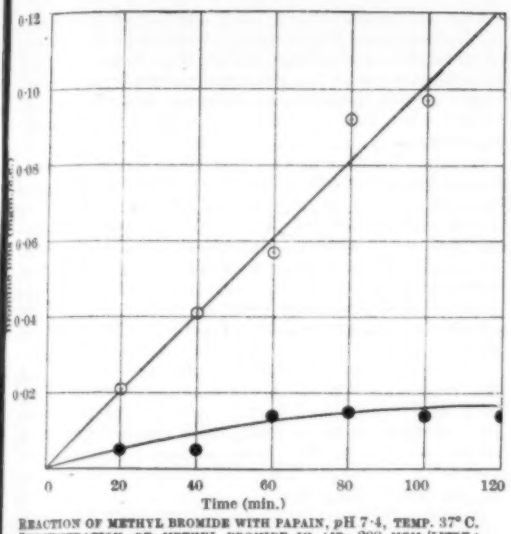
As a result of the above evidence, tests were carried out on some of those enzyme systems known to require the presence of SH groups for their activity. In each of the following tests the enzyme suspensions contained in all-glass flasks were exposed to known concentrations of methyl bromide at 37° C. At the end of each exposure, the free methyl bromide was removed by evacuation and 'air washing'. In each of the following systems, where free SH groups were present, exposure to methyl bromide vapour produced a progressive and irreversible inhibition.

Urease. A 1 per cent urease suspension, prepared from B.D.H. urease tablets, was used as a source of enzyme, and the activity after exposure to methyl bromide was measured by the method of Sumner[17].

Succinic dehydrogenase. An active extract of heart muscle was prepared and dissolved in phosphate buffer *p*H 7·4. After exposure to methyl bromide, the activity of the preparation was determined by measuring the oxygen uptake in the presence of 0·05 *M* sodium succinate. That the cytochrome oxidase portion of the system is not inhibited was shown by the fact that the addition of methylene blue did not increase the rate of oxygen uptake.

Papain. A 0·1 per cent aqueous extract of B.D.H. papain was treated with methyl bromide when in the reduced and also in the oxidized form. In each case the enzyme was activated with 2*M* sodium cyanide immediately before measurement of activity by the method of Anson[18]. The enzyme was rapidly inactivated by methyl bromide when exposed in the reduced form, but almost unaffected when oxidized. Simultaneous determinations of non-volatile bromide showed that the methyl bromide only reacted with the enzyme when the latter was in the reduced form (see graph).

Yeast (respiration). Fresh yeast suspended in buffered saline solution was exposed to methyl



REACTION OF METHYL BROMIDE WITH PAPAIN, *p*H 7·4, TEMP. 37° C. CONCENTRATION OF METHYL BROMIDE IN AIR, 200 MGM./LITRE; —○—, REDUCED PAPAIN; —●—, OXIDIZED PAPAIN

bromide for periods up to 15 hours. After washing in isotonic saline, the oxygen uptake in the presence of glucose was measured. The reduction in oxygen uptake was accompanied by a rapid accumulation of acetaldehyde, which was readily detectable in the respiration flasks.

A few typical results obtained in the above tests are given in Table 2, together with the molar concentrations of methyl bromide dissolved in the solutions.

Enzyme systems containing essential SH groups show considerable variation in their sensitivity to inactivating agents, and it is not possible, therefore, to make direct comparisons between different systems. If the toxicity of methyl bromide to animal and plant life is to be attributed to its ability to inactivate SH enzymes, some system forming an essential link in the chain of metabolic processes must be shown to be inhibited. Evidence of such inhibition in carbohydrate metabolism has been provided by Dixon[19], who has shown that hexokinase, which is present in the brain[20], is inhibited by methyl bromide. It is hoped that further work on this and other systems such as pyruvate oxidase will provide further information. The present findings do show, however, that methyl bromide is capable of combining with SH groups and producing a progressive and irreversible inhibition of those enzymes which have been tested. Such inhibition of an enzyme system in the brain would readily produce functional disturbances such as those associated with methyl bromide poisoning.

TABLE 2

Enzyme	Concentration of methyl bromide in air (mgm./litre)	Molar concentration of methyl bromide in solution	*p*H	Time of treatment (hr.)	Percentage inhibition
Urease	420	0·012	9·0	1	24
	420	0·012	9·0	2	52
	420	0·012	7·74	1	12
	420	0·012	7·74	2	29
Succinic dehydrogenase	500	0·014	7·4	1	41·5
	500	0·014	7·4	2	81·0
Papain (reduced)	400	0·011	9·0	1/3	100
	400	0·011	7·4	1	67
	400	0·011	7·4	2	100
	190	0·0054	7·4	1	49
	190	0·0054	7·4	2	75
Papain (oxidized)	400	0·011	9·0	2	7
Yeast (respiration)	35	0·001	5·3	15	66
	22	0·0006	5·3	11	50
	165	0·0046	7·1	1	55
	165	0·0046	7·1	2	70

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DETERMINATION OF RADIOACTIVE AND STABLE TRACER ISOTOPES

A MEETING of the Physical Methods Group of the Society of Public Analysts and other Analytical Chemists was held at the University of Birmingham on April 2. During the afternoon, about forty members visited the Physics Department at Edgbaston. Prof. P. B. Moon gave a short preliminary talk on the cyclotron and the synchrotron, and after a second short talk on target chemistry by Dr. F. E. Whitmore, parties were shown over the laboratories where the 60-inch cyclotron, now almost completed, was on view. The method of constructing the 800-ton magnet of the new synchrotron was explained in detail, and in smaller research laboratories several demonstrations had been arranged of experiments in radioactivity. After tea in the refectory at Mason's College, Edmund Street, the main business of the meeting was conducted under the chairmanship of Dr. J. G. A. Griffiths. Prof. M. Stacey welcomed the Physical Methods Group to Birmingham and stressed the importance of isotope measurements in a wide variety of fields.

A short symposium on "The Determination of Radioactive and Stable Tracer Isotopes" was opened by Dr. A. G. Maddock with a paper on problems in

the measurement of β-activity, such as are met with in everyday practice. In spite of the development of ionization chambers connected to electroscopes or to electrometer valve circuits, and even of the more recent use of photomultiplier tube counters, the Geiger–Müller counter remains the most sensitive measuring device for β-rays. After mentioning briefly the working of such a counter, Dr. Maddock discussed the characteristics of the best counters and the means of avoiding spurious counts by using a quenching circuit such as that of Getting. Reduction of the background count of a Geiger–Müller tube can be very important where low activities are to be measured, and Dr. Maddock advocated careful selection of lead for 'castles' to shield counters and satisfactory design of both 'castle' and radioactive sample holder. That part of the background count—about half of it—which is due to cosmic radiation can be eliminated by the use of a second counter directly above the first and connected to it in an anticoincidence circuit.

If samples for counting are neither infinitely thin nor infinitely thick, a correction must be applied for self-absorption of β-rays in the sample. In a series of experiments when the same radioisotope is always used, it is worth constructing an empirical correction curve. Where several different isotopes are in use, however, corrections for self-absorption can be made with reasonable accuracy through the use of a nomogram connecting thickness of sample with half-absorption thickness of the isotope involved.

Dr. F. E. Whitmore followed, with a paper in which he considered the accurate estimation of radioisotopes the decay schemes of which are more complicated than those of a simple β-active isotope. Zinc 65, for example, has an exceptionally complicated decay scheme involving positrons with their accompanying annihilation γ-radiation and, in addition, γ-rays and X-rays arising from *K*-capture. All these types of radiation will affect a Geiger counter, but with differing efficiencies. Dr. Whitmore described an arrangement of two counters such that effectively one is sensitive only to γ-rays and the other only to β-rays, counts being measurable from each separately and the two in coincidence. In the case of an isotope decaying with β- and γ-rays simultaneously, the absolute number of disintegrations per second occurring in the sample can be found in terms of these counts only, independently of the β- and γ-efficiencies of the counters.

A further possible use of coincidence counting was suggested by Dr. Whitmore, in that two counters in coincidence are directional for γ-rays and might be used for the location of γ-active material in a living body, in place of the present arrangement whereby a single counter is used at the end of a long hole in a lead block.

The subject of measurement of the relative abundances of inactive isotopes was introduced by Dr. E. R. S. Winter, who first described briefly the development of the mass spectrometer and then, in greater detail, the construction of a modern mass spectrometer of the Nier 60° type. The instrument was considered in its three main parts of ion source, magnetic analyser and collector cup. By means of a block diagram, the equipment ancillary to the mass spectrometer tube was clearly demonstrated, and Dr. Winter explained the importance of slit widths and alignment in determining resolving power and the shape of mass peaks. There must be adequate separation between peaks over the mass range in which the instrument is being used, and if the tops of the peaks are flat, accurate measurement of mass abundance is made much easier. Dr. Winter pointed out the virtues of the mass spectrometer, this being a remarkably flexible and accurate instrument and much the best means of measuring isotopic abundances.

The feasibility of methods of stable isotope analysis using apparatus other than the mass spectrometer was the subject of a paper by Dr. E. R. Roberts. The high cost and complexity of mass spectrometers make it worth while to examine methods less elegant and more tedious which may yet be used in tracer experiments with stable material. Such methods include density measurements in both gas and liquid phases, and measurement of thermal conductivity in gases.

Quartz buoyancy balances similar to those used in the determination of the molecular weights of the rare gases can be used in the estimation of deuterium in hydrogen–deuterium mixtures. Accuracy is good in the case of hydrogen and deuterium; but improvements in technique may be necessary if heavier elements are to be used.

Several different liquid density methods have been used, again mostly for estimation of deuterium oxide in water. The most accurate is the determination of flotation temperature using a silica float calibrated with known water–heavy water mixtures. Determination of density by micro-pyknometer is also satisfactory, and in both these cases rigid chemical purification of the water is necessary. Another method of density determination is the falling-drop method, where drops of water fall through a very pure liquid in which they are non-miscible and which is of known density. Dr. Roberts also described the method of comparison of thermal conductivities, which has the advantage of requiring only very small quantities of sample.

Some examples of the use of tracer isotopes in the biological field were presented by Dr. W. J. Arrol, who did not attempt a survey of all the isotopes which have been used, but considered only iodine 131 of half-life 8 days. The uptake of iodine into the thyroids of human patients can be followed by placing a γ-counter over the gland and plotting activity of the gland against time after a single dose of radioiodide has been administered. The curve obtained can be used to diagnose departures from normal conditions both qualitatively and to some extent quantitatively, and more applications of tracer methods to diagnostic problems can be expected.

Two matters of importance to biochemists are the positive identification of the compound in which a tracer atom is combined, and the identification of the biological precursor of a compound. Dr. Arrol quoted in the first case the method used by Morton and Chaikoff in confirming the presence of radioiodine, from radiodide incubated with thyroid tissue, in thyroxine and diiodotyrosine extracted from the tissue. The radioactive residue extracted by an ordinary procedure is mixed with pure inactive compound and repeatedly crystallized. If the specific activity of the crystals remains constant, the radioactive residue is not chemically distinct from the pure compound with which it was mixed.

If a number of different 'labelled' compounds are administered to an animal and one is found to be converted to a particular compound with greater efficiency than the others, it is quite likely to be the direct biological precursor. In a few cases, more

evidence is obtainable by applying the criterion of Zilversmit, Entenman and Fishler, whereby variation of specific activity of a compound in a tissue with time and the variation with time of its immediate precursor are in a definite relationship with one another.

Dr. Arrol described the technique of making radioautographs and mentioned that recent improvements meant that accumulations of 8-day radioiodine 2·5 microns apart in a sample could be resolved in the radioautograph.

It was unfortunate that lack of time prevented any discussion on the papers, particularly as members were unable to bring up questions concerning the application of tracer methods to their own problems. The full text of the papers will be published in *The Analyst* in due course.

INTERNATIONAL RADIO CONFERENCES

TWO international radio conferences are being held in Stockholm during July. One of these will deal with the more fundamental aspects of radio science, while the other will be concerned with technical problems which form the basis of the practice of telecommunications. The two bodies, under the auspices of which these conferences are held, are in a sense complementary to one another in their functions; but there is naturally a good deal of common ground in their activities, and the choice of an arrangement of concurrent meetings this summer would appear to be a very happy one.

(1) *Union Radio Scientifique Internationale* (*U.R.S.I.*). The object of the International Scientific Radio Union is to promote scientific research in radio technique, particularly in those fields in which international co-operation is desirable or necessary. The Union is a constituent body of the International Council of Scientific Unions. Its headquarters and general secretariat are situated in Brussels, and the president is Sir Edward Appleton. The Union has held general assemblies in Washington, Brussels, Copenhagen, London, Venice (1938) and Paris (1946), at each of which a British delegation participated. The next general assembly will be held in Stockholm during July 12–22.

The work of the Union is divided between four Commissions, the titles and presidents of which are as follow: (I) Standards and Measurements, Dr. J. H. Dellinger (United States); (II) Propagation of Waves, Sir Edward Appleton (Great Britain); (III) Radio Noise, M. R. Bureau (France); (IV) Radio Physics, Prof. van der Pol (Netherlands). In addition to dealing with affairs at the general assemblies, these Commissions, together with any sub-commissions appointed from time to time, deal by correspondence, between the successive general assemblies, with work in the fields indicated by their titles.

The British National Committee for Scientific Radio is organised under the auspices of the Royal Society, as a constituent member body of Union Radio Scientifique. It comprises a few members appointed by the Royal Society, and in addition representatives of the Department of Scientific and Industrial Research, the Radio Research Board, the National Physical Laboratory, General Post Office, British Broadcasting Corporation, Wireless Telegraphy Board, Meteorological Office, Institution of Electrical Engineers, Physical Society, Royal Society of Edinburgh and Royal Irish Academy.

It is customary for the various national committees to submit to each general assembly progress reports reviewing the advances made within their own countries in each of the fields of research designated by the above Commissions, and to submit any proposals for international action, which may include theoretical and experimental research, and, where desirable, standardization of equipment and nomenclature. As two examples of subjects in which this type of international action has been of great benefit to both the science and practice of telecommunications, those of frequency measurement and standardization and the study of the characteristics of the ionosphere may be quoted. In the former case, the connexions available through the Union have been instrumental in obtaining international agreement on the standards of frequency to a very high order of accuracy; while, in addition, the very advanced state of our knowledge of the ionosphere and of its influence on radio wave propagation owes much to the agreement obtained through the Union as to the essential quantities to be measured and the techniques used in doing so.

In addition to the preparation and submission of progress reports, the Union welcomes at its assemblies brief accounts of any outstanding and novel lines of recent research. In this case, the Union does not act as an alternative means of securing original publication, but rather as a forum for the discussion of appropriate items of work published in the normal manner elsewhere; and its own published account of such items is limited to about five hundred words.

The progress reports and the abstracts of original work referred to above are published by the Union in documents which contain also the proceedings and resolutions of each general assembly.

(2) *Comité Consultatif International des Radio-Communications* (*C.C.I.R.*). The International Advisory Committee for Radio is one of three technical committees which advise the International Telecommunications Union (I.T.U.) on all aspects of radiocommunication. The other two corresponding bodies are concerned with land-line telegraphy and telephony respectively.

The Committee is organised under the auspices of the Bureau of the International Telecommunications Union, with headquarters and secretariat at Berne. The Union itself is concerned with the framing of the general regulations which govern radiocommunication on an international basis and with the allocation of the frequencies required by different countries for various services in all parts of the world. For this purpose conferences of the Union were held at Cairo in 1938 and at Atlantic City in 1947; and the duty of the International Committee, which last met at Bucharest in 1937, is to study the technical problems associated with radiocommunication particularly in regard to its international aspects and to make appropriate recommendations to the Union for regulation.

It will thus be clear that the Committee is concerned with the technical problems which arise in the practice and operation of radiocommunication, and its members are the various national administrations controlling such communications. In the United Kingdom, the General Post Office is the appropriate administration for arranging for a delegation to participate in meetings of the International Advisory Committee; and for this purpose,

that department organises a committee, with appropriate study groups, to prepare the documents to be submitted to the international conference. The committee contains representatives of all bodies, including Government departments and industrial organisations, concerned with the technical aspects of radio communication.

The next conference of the International Committee will be held in Stockholm during July 12–31, and among the subjects being studied in preparation for this are: (*a*) separation between frequencies assigned to radio stations; (*b*) international co-ordination of investigations on propagation; (*c*) methods of measurement of the field-strength of signals and of noise; (*d*) standard frequency and time-signal broadcasts; (*e*) monitoring of communication services; (*f*) distress signals.

INDIAN RESEARCH FUND ASSOCIATION

THE report of the Scientific Advisory Board of the Indian Research Fund Association (New Delhi) for the year ended December 31, 1946, gives some account of the researches carried out during the year on cholera, malaria, nutrition, leprosy, plague, pharmacology, maternity and child welfare, filariasis and other subjects, and includes the reports of the advisory committees as well as a list of papers published under the auspices of the Association, and the programme of researches and miscellaneous grants recommended for the financial year 1947–48. A cholera inquiry commenced at the Central Research Institute, Kasauli, is concerned with the substance and variability of the vibrios which may affect the efficiency of the vaccine used in cholera prophylaxis. The insecticide and mosquito repellent inquiry under the director of the Malaria Institute of India, Delhi, has covered the preparation of D.D.T. emulsion concentrates and aqueous suspensions, and field trials of D.D.T. solution, emulsions and suspensions and of 'Gammexane' solutions as residual sprays, as well as of turpentine, turpentine–toluene, and turpentine–rosin soap emulsions. A mammalian malaria inquiry covered studies of the experimental mosquito transmission of *Plasmodium cynomolgi* to *Macaca muletta* monkeys and the course of the infection and of the transmission of *P. cynomolgi* by blood and tissue sub-inoculation during the incubation period following sporozoite injection. An investigation of adult *Anopheles stephensi* was initiated at the School of Tropical Medicine, Calcutta, and another on the control of sand-flies, *Phlebotomus argentipes*, by spraying with D.D.T.

Nutrition researches under Dr. V. N. Patwardham at Coonoor have included studies of the vitamins of the B complex and the supplementary value of groundnut and coconut oil cakes in poor rice diets. Under Dr. B. N. Ghosh, at the University College of Science and Technology, Calcutta, studies of the biosynthesis of ascorbic acid by the rat have continued, as well as the inquiry into the chemical nature and nutritional availability of iron in foods; and the formation, function and variations of plasma proteins in health and disease have been investigated at the Grant Medical College, Bombay. The nutrition research unit at the University of Dacca has studied the metabolism of fat, the vitamin B complex, the relation between carbohydrate metabolism and nicotinic acid, the effect of soy-bean milk on growth; the similar unit at Seth G.S. Medical College, Bombay, in addition to fat metabolism, vitamin D and the enzymic liberation of nicotinic acid, has studied the nutritive value of pure-bred strains of cereals and pulses. In the laboratories of the Council of Scientific and Industrial Research at Delhi, a more exact determination has been made of the vitamin A activity of eighty-seven foodstuffs on the basis of individual carotenoids present. At the Women's Christian College, Madras, poor rice diets and food preparations in common use in South India have been investigated, and the evaluation of proteins in terms of hæmopoietic activity and the relation of dietary protein to blood and muscle hæmoglobin has been studied at the Biochemical Laboratory, University of Madras. The preparation of anti-rachitic substances and the nutritive value of soy-bean milk have also been studied at Poona and at Bangalore, respectively.

Leprosy research during the year at the School of Tropical Medicine, Calcutta, has included studies of promin, diasone, hydnocarpic derivatives of sulphonamides and aspergillin for the treatment of leprosy; work with stilbamidine has been continued and work with streptomycin has been concerned with its production from *Actinomyces griseus*. Some clinical, bacteriological and immunological work is also reported. Plague researches at the Haffkine Institute have included the effect of D.D.T. dust on the breeding of the Indian rat-fleas, *Xenopsylla cheopis* and *X. astia*; fumigation work with 'Cyanogas' and experiments with D.D.T. as pulicide are also described. Among the chemical researches reported may be mentioned that on Naga sore at the Pasteur Institute, Shillong, on hypoproteinæmia and other conditions associated with malnutrition and on erythroblastosis fœtalis and its association with the *Rh* factor at the School of Tropical Medicine, Calcutta, and the study of the anatomy of the foot with reference to infections of the foot at Stanley Hospital, Madras.

In pharmacology, the indigenous drugs inquiry has included studies of the effect of different methods of drying and of the age of the plants on the pyrethrum content of pyrethrum flower-heads, and on essential oil-bearing plants of the Kashmir valley. In the filariasis inquiry at the School of Tropical Medicine, Calcutta, the study of the action of the antimony compounds stibatin and anthiomaline was continued, while the hæmatological unit studied the blood picture and protein content of healthy Indian vegetarians. Chemotherapeutic investigations on kala-azar, the production of penicillin, anthelmintic trials of indigenous drugs against hookworm and ascaris infestation, the serological diagnosis of typhus fever by the Weil–Felix reaction and isolation of rickettsial strains, anaerobic wound infections, the manufacture of influenza virus A vaccine, the behaviour of membrane vaccine lymph in the field and the effect of cobra venom on the aerobic oxidation of *d*-glutamic acid are among the miscellaneous researches reported.

The reports of the advisory committees cover much the same ground but include a number of important appendixes. Among these may be mentioned a summary of work done on cholera at the Haffkine Institute, a note of the recommendations for the fortification of staple foodstuffs from the Food Fortification Sub-Committee of the Nutrition Advisory Sub-Committee, and a note on the nutritive value of 'Vanaspati' or hydrogenated vegetable oils. A

scheme for the investigation of lathyrism, and notes on suggested lines of work on shock, the segregation and treatment of cases of tetanus with the view of clinical trials of *V*-187 in India, on the classification of clinical tetanus, and on a technique for removal of the brain and spinal cord in cases of lathyrism are also given. There are also reports on the distribution of typhus fever in the army in India, 1943–46, and of the sub-committee appointed to examine the possibility of maintaining sickness absenteeism records in Indian industries.

LATIN AMERICAN CULTURES

THE Institute of Social Anthropology, which has recently been formed within the Smithsonian Institution, has started to issue an important series of monographs*. The five which have so far appeared deal with Latin America and have a very wide range. Their object is both scientific and practical, and the co-operation afforded by the national authorities both in Mexico and in Peru is a measure of the importance which they ascribe to the work. Leaving aside No. 1, on houses and house use of the Sierra Tarascans, which was published so long ago as 1944, the following brief comments are intended to give some indication of the nature of the series.

Nos. 2 and 3 are detailed studies of a small highland town in Mexico and of a coastal town of the same order of magnitude on the coast of Peru. Although the people of Cherán are Tarascan Indians, with little white blood, speaking their native language and living principally by agriculture like their forefathers, the conclusion is reached that most traits of their culture are derived from Europe. This is not to say that it is a European culture, since the contact with indigenous Tarascan elements has caused it to develop into something distinct from either; in fact, into what Mr. Gillin, in his monograph on Moche, would describe as a Creole culture.

Moche is by comparison a drab place, as the useful series of photographs in each publication will show, but Mr. Gillin's analysis proves that its culture contains a far higher proportion of indigenous elements. The town lies almost under the shadow of the two great pyramids of Moche, and, like them, owes its name to the ancient Mochica culture; but this had at least two successors before the Spanish Conquest, so it must not be expected that much of it has survived unmodified to the present time, as Mr. Gillin is careful to point out; and the remaining aboriginal elements are common to a number of pre-Colombian cultures rather than specific to the Mochica. The difference between the two towns is well illustrated by the accounts given of witchcraft in each of them. The data for Cherán are far from complete, but what there are have a completely European aspect, whereas those for Moche, which are fuller, have a predominantly shamanistic complexion. In spite of the aboriginal survivals, however, the author shows that Moche has a Creole culture rather than an Indian one, but considers it likely that it has changed considerably in this sense during the past generation.

No. 5 is a preliminary study, undertaken in order to choose a suitable place for more detailed work. It brings out the great variety in degree of change from Indian to white culture which is found in the Central Andes of Peru. One of its most illuminating features is a discussion of what constitutes an Indian, showing that racial criteria are so difficult to apply that a cultural definition is generally the only practicable one. In addition to introductory matter, which includes general accounts of the geography and the population, the paper contains interesting brief descriptions of most of the places visited. The town of Sicaya was chosen for further study, on the ground that it demonstrated best the process by which an Indian acquires a Mestizo culture and the Mestizo a white culture.

No. 4 is a voluminous and well-illustrated work, containing the geographical materials which an anthropologist needs to build on, particularly with regard to the use of land, and which he too often has to neglect owing to lack of specialized training. It will, presumably, be followed up by more purely anthropological studies. G. H. S. BUSHNELL

* 2. Cherán: A Sierra Tarascan Village. By Ralph L. Beals. Pp. x+225+8 plates. 3. Moche: a Peruvian Coastal Community. By John Gillin. Pp. vii+166+26 plates. 4. Cultural and Historical Geography of Southwest Guatemala. By Felix Webster McBryde. Pp. xv+184+47 plates. 5. Highland Communities of Central Peru: a Regional Survey. By Harry Tschopik, Jr. Pp. viii+56+15 plates. 50 cents each. (Pub. 2–5 of the Institute of Social Anthropology, Smithsonian Institution, Washington, D.C.)

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Saturday, May 1

BRITISH PSYCHOLOGICAL SOCIETY (in the Physiology Theatre, University College, Gower Street, London, W.C.1), at 2.30 p.m.—Mr. David Katz: "Gestalt Laws of the Body Scheme".

Monday, May 3

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—Lord Teviot: "The Lucas Report".

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE (at Houghton Street, Aldwych, London, W.C.2), at 5 p.m.—Prof. Frank H. Knight: "Economic Theory and the Good Society". (Further Lectures on May 10, 24, 31, June 7 and 14.)*

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. W. T. Winter: "The Development of the Jet Propulsion Engine".

CHEMICAL SOCIETY, LEEDS SECTION (in the Chemistry Department, The University, Leeds), at 6.30 p.m.—Prof. Linus C. Pauling, For. Mem.R.S.: "The Valence of Metals and the Structure of Intermetallic Compounds".

SOCIETY OF CHEMICAL INDUSTRY (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Annual General Meeting: Mr. B. A. Southgate: "The Treatment and Disposal of Waste Waters from Industry".

Monday, May 3—Friday, May 7

LIBRARY ASSOCIATION (in the Spa Grand Hall, Scarborough).—Annual Conference.

Tuesday, May 4

COUNCIL FOR THE PRESERVATION OF RURAL ENGLAND (at the Royal Institution of Chartered Surveyors, 12 Great George Street, London, S.W.1), at 2.30 p.m.—Annual General Meeting.

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE (at the Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Annual General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE (joint meeting with the INTERNATIONAL AFRICAN INSTITUTE, at 21 Bedford Square, London, W.C.1), at 5 p.m.—Dr. Max Gluckman, Mr. J. H. Barnes and Mr. J. C. Mitchell: "The Village Headman in British Central Africa".

SOCIETY OF CHEMICAL INDUSTRY, CHEMICAL ENGINEERING GROUP (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. J. N. Pring: "Modern Propellants Employed in British Ordnance".

Wednesday, May 5

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Dr. F. G. Mann, F.R.S.: "Recent Advances in Stereochemistry" (Pope Memorial Lecture).

PHYSICAL SOCIETY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 4 p.m.—Annual General Meeting: at 5 p.m.—Prof. Yves Rocard: "Sur les conditions d'autooscillation des systèmes vibrants" (Third Holweck Discourse).

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, SOCIAL PHILOSOPHY SECTION (at the Portico Library, Manchester), at 5.30 p.m.—Prof. J. A. Hawgood: "Education in Germany".*

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 7 p.m.—Scientific Papers.

Wednesday, May 5—Thursday, May 6

IRON AND STEEL INSTITUTE (at the Royal Institution of Chartered Surveyors, 12 Great George Street, London, S.W.1).—Annual General Meeting.

Wednesday, May 5

At 9.45 a.m.—Morning Session; at 2.30 p.m.—Afternoon Session; at 8.30 p.m.—Prof. Robert F. Mehl: "The Decomposition of Austenite by Nucleation and Growth Processes" (Third Hatfield Memorial Lecture).

Thursday, May 6

At 9.30 a.m.—Morning Session.

Thursday, May 6

ROYAL SOCIETY OF ARTS, INDIA, PAKISTAN AND BURMA SECTION (joint meeting with the EAST INDIA ASSOCIATION, at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Sir Frederick E. James: "Tatas—a Story of 60 Years' Industrial Development in India".

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

CHEMICAL SOCIETY, MANCHESTER SECTION (in the Chemistry Department, The University, Manchester), at 6.30 p.m.—Prof. Linus C. Pauling, For.Mem.R.S.: "The Chemical Bond".

CHEMICAL SOCIETY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 7.30 p.m.—Sir John Lennard-Jones, F.R.S.: "The Molecular Orbital Theory of Valency".

Saturday, May 8

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, DIVISION FOR SOCIAL AND INTERNATIONAL RELATIONS OF SCIENCE (at the Assembly Hall, Leamington Spa), at 2 p.m.—Conference on "Human Factors in Industry".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURERS IN MATHEMATICS, a LECTURER IN PHYSICS, a LECTURER IN CHEMISTRY, a LECTURER IN BIOLOGY, SENIOR ASSISTANTS (2) to teach CIVIL AND MECHANICAL ENGINEERING subjects to Honours degree standard, LECTURERS IN ENGINEERING to teach in some selected branch of Civil or Mechanical Engineering up to Degree standard, LECTURERS IN ENGINEERING to teach classes of a Workshop and Production Engineering character up to Higher National Certificate, and a LECTURER IN ELECTRICAL ENGINEERING—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, London, S.E.18 (May 8).

PRINCIPAL RESEARCH OFFICER to supervise the Electronics, Acoustics and Electrical Standards Sections of the Electro-Technical Division of the South African National Physical Laboratory, Pretoria—The South African Scientific Liaison Officer, Africa House, Kingsway, London, W.C.2 (May 10).

LECTURER IN AGRICULTURE (HEAD OF THE DEPARTMENT)—The Director of Agriculture, School of Agriculture, Houghall, Durham (May 10).

SPECIALIST IN VISUAL AIDS at the Ministry of Education—The Secretary, Civil Service Commission, 6 Burlington Gardens, London, W.1, quoting No. 2158 (May 13).

LECTURER (Grade III) IN MECHANICAL ENGINEERING—The Registrar, Queen Mary College, Mile End Road, London, E.1 (May 14).

LECTURER IN CHEMISTRY with special reference to Electrochemistry, and a RESEARCH ASSISTANT IN THE ZOOLOGY DEPARTMENT for work on Neurotoxic Insecticides with reference to problems of Locust Control—The Secretary of University Court, The University, Glasgow (May 15).

LECTURER (Grade II) IN STATISTICS, and an ASSISTANT LECTURER (Grade III) IN APPLIED MATHEMATICS—The Registrar, The University, Liverpool (May 15).

LECTURER IN THE MATHEMATICS DEPARTMENT—The Principal, Heriot-Watt College, Edinburgh (May 15).

LECTURER IN NATURAL PHILOSOPHY IN UNIVERSITY COLLEGE, Dundee—The Secretary, The University, St. Andrews (May 15).

LECTURER IN CHEMISTRY—The Secretary, The University, Aberdeen (May 17).

LECTURER IN GEOGRAPHY—The Registrar, The University, Reading (May 24).

PRINCIPAL SCIENTIFIC OFFICER for Accidents Investigation in the Royal Aircraft Establishment, South Farnborough—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2153 (May 25).

PRINCIPAL SCIENTIFIC OFFICER, and a SENIOR SCIENTIFIC OFFICER, in the Ministry of Agriculture and Fisheries for employment at the Plant Pathology Laboratory, Harpenden—The Secretary, Civil Service Commission, Scientific Branch, 27 Grosvenor Square, London, W.1, quoting No. 2151 (May 26).

LECTURER IN APPLIED MATHEMATICS—The Secretary, The University, 38 North Bailey, Durham (May 29).

LECTURER IN THE TECHNICAL DEPARTMENT (for City and Guilds Telecommunications up to Grade 5)—The Technical Officer, University College, Southampton (June 12).

ASSISTANT LECTURERS (2, Grade III), mainly for research in Plankton and Algology, at the Port Erin Marine Biological Station—The Registrar, The University, Liverpool (July 15).

DESIGN ENGINEERS (Instruments), and STANDARDS ENGINEERS, IN THE DEPARTMENT OF ATOMIC ENERGY (Production)—The Staff Section, Ministry of Supply, Department of Atomic Energy, Risley, Warrington, Lancs.

LECTURER IN THE MATHEMATICS DEPARTMENT—The Principal, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER IN STATISTICS, a LECTURER (Grade I) IN PHYSICS, and a LECTURER (Grade II) IN PHYSICS—The Registrar, The University, Reading.

LECTURER IN ANATOMY (to take charge of dental and massage classes), in the University of Otago, Dunedin—The High Commissioner for New Zealand, 415 Strand, London, W.C.2.

LECTURER IN CHARGE OF AGRICULTURAL CHEMISTRY DEPARTMENT—The Secretary and Bursar, Seale-Hayne Agricultural College, Newton Abbot, Devon.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Vision. (Published 3 times a year). No. 1: Autumn. Pp. 36. (London: Association of Optical Practitioners, 1947.) 1s. [1610

British Journal of Nutrition. (Quarterly.) Vol. 1, No. 1, September. Pp. ii + 108. (Cambridge: At the University Press, 1947.) 20s. net; annual subscription, £3. [2110

Rubber Developments. Vol. 1, No. 1, September. Pp. 40. (London: British Rubber Development Board, 1947.) [2110

Ministry of Fuel and Power. Report on the Petroleum and Synthetic Oil Industry of Germany to the Rt. Hon. Emanuel Shinwell. By a Mission from the Ministry of Fuel and Power. Pp. v + 134. (London: H.M. Stationery Office, 1947.) 10s. net. [2011

Air Transport and Geography. By W. G. V. Balchin. Pp. 23. (London: Royal Geographical Society, 1947.) 1s. [11

British Journal of Radiology. Supplement No. 1: Report of London Conference held May 13–14, 1946, on Certain Aspects of the Action of Radiation on Living Cells. Edited by F. G. Spear. Pp. 146. (London: British Institute of Radiology, 1947.) 15s. 6d. [11

Other Countries

The Round Earth on Flat Paper. Map Projections used by Cartographers. by Wellman Chamberlin; Map Services of the National Geographic Society, by Gilbert Grosvenor. Pp. 126. (Washington, D.C.: National Geographic Society, 1947.) 60 cents. [196

The Indian Archives. (Quarterly.) Vol. 1, No. 1, January 1947. Pp. 96. (New Delhi: Imperial Record Department, 1947.) 2 rupees; annual subscription, 8 rupees. [266

Evolution: International Journal of Organic Evolution. Published quarterly by the Society for the Study of Evolution. Vol. 1, Nos. 1–2, March-June. Pp. 112. (Chicago: Society for the Study of Evolution, c/o Chicago Natural History Museum, 1947.) Single Nos., 1.50 dollars: 6 dollars per vol. [266

D.D.T. for Control of Household Pests. Pp. 16. (Washington, D.C.: Government Printing Office, 1947.) 5 cents. [266

Surgery. Being Section 9 of Excerpta Medica. Vol. 1, No. 1, September. Pp. 122. (Amsterdam: N.V. Excerpta Medica, 1947.) 25 dollars; £6 4s., per year. [1510

Endocrinology (Experimental and Clinical). Being Section 3 of Excerpta Medica. Vol. 1, No. 1, August. Pp. 66. (Amsterdam: N.V. Excerpta Medica, 1947.) 15 dollars; £3 15s., per year. [1510

Unasylva. A magazine of Forestry and Forest Products published bi-monthly. Vol. 1, No. 1, July–August. Pp. 64. (Washington, D.C.: Food and Agriculture Organization of the United Nations, 1947.) 65 cents; 3.50 dollars per year. [1610

The Tropic Proofing of Optical Instruments. By Prof. J. S. Turner, Assoc. Prof. Ethel I. McLennan and J. S. Rogers. Pp. 80 + 7 plates. (Melbourne: Prof. J. S. Turner, Botany Department, The University, 1947.) [1610

Information: Journal of the Association of Special Libraries and Information Services. Vol. 1, No. 1, June. Pp. 32. (Melbourne: Association of Special Libraries and Information Services, 1947.) 25s. per year. [2110

Marriage Hygiene, Second Series. (Published quarterly.) Vol. 1, No. 1, August. Pp. 64. (Bombay: Whiteaway Building, Hornby Road, 1947.) 3.8 rupees, 6s.; 12 rupees, 22s., per year. [2110

Science, Government and Industry. Inaugural of the Arthur Dehon Little Memorial Lectures at the Massachusetts Institute of Technology, at Cambridge, Massachusetts, November 19, 1946. By Sir Edward V. Appleton. Pp. 38. (Cambridge, Mass.: Massachusetts Institute of Technology, 1946.) [2210

Catalogues

Galvanometer Susp n ion Strip. (Publication 2537.) Pp. 4. Permanent Scales a d M rks on Glass. (Publication 2572.) Pp. 4. (London: Johnson, Matthey and Co., Ltd., 1947.)

Hydrogen Ions: pH Measurement with particular reference to the Glass Electrode. Pp. iv + 44. (St. Albans: Marconi Instruments, Ltd., 1947.)

The Aluminium Courier. No. 1, August. Pp. 8. (London: Aluminium Development Association, 1947.)

Chemicals. Pp. 16. (West Bromwich: Robinson Brothers, Ltd., 1947.)

A Catalogue of Books and Manuscripts issued to commemorate the One Hundredth Anniversary of the Firm of Bernard Quaritch, 1847–1947. Pp. xvii + 91 + 20 plates. (London: Bernard Quaritch, Ltd., 1947.)

Winter Washes and Spraying Programmes. Pp. 20. (Wheathampstead: The Murphy Chemical Co., Ltd., 1947.)

Muirhead-Wigan Decade Oscillator, Type D-105-A. (Bulletin B-528-D.) Pp. 2. (Beckenham: Muirhead and Co., Ltd., 1947.)

A Catalogue of Scientific Apparatus for Lecture and Laboratory Use in the Study of Physics, Chemistry, Biology and General Science for University and other Examinations. (Catalogue 52 AB.). Pp. vi + 616. (London: Griffin and Tatlock, Ltd., 1947.)

Sciex Bulletin. No. 1 Technical Series. Pp. 16. (London: Scientific Exports (Great Britain), Ltd., 1947.)

A Miscellany of Books from the 16th to the 20th Century. (Catalogue No. 504.) Pp. 42. (Cambridge: Bowes and Bowes, 1947.)

Self Centring Lens Edging Machine; Toric Ophthalmic Lens Grinding Machine. Pp. 4. (Leicester: Adcock and Shipley, Ltd., 1947.)